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THE ORIGIN OF THE BANANA INFLORESCENCE.

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Introduction

Different views have been expressed in the literature concerning the morphology of the unusual inflorescence of *Musa* L. Most of the early investigators expressed their views after having examined adult specimens only. The most recent paper dealing with this problem was published by McLean Thompson in 1933, and is based on ontogenetic investigations on some species of *Musa* L.

While examining other species of *Musa* than those to which McLean Thompson refers in his paper, I found ontogenetic evidence that the succession of flowers in the flower-groups of the inflorescence differs from that which he described for the species of *Musa* which he studied. The present paper has accordingly been written in the hope of throwing more light on this interesting problem of the origin of the banana inflorescence.

Previous views on the nature of the banana inflorescence.

The banana inflorescence consists of a main axis on which flattened groups of flowers are arranged in spiral rows, where they arise from low cushions. The direction of these spiral rows is anti-clockwise. Every cushion with its flower-group arises from the axil of a large bract, and there is no separate bract to each individual flower. The flowers of each group are arranged in one or two rows orientated tangentially in relation to the main inflorescence axis. In the species, where the flowers in the flower-groups are arranged in 2 rows, those of one row alternate with those of the other.

This unusual arrangement of the flowers on low tangentially elongated cushions has led to speculation concerning the correct interpretation of the nature of the banana inflorescence. McLean Thompson (1933) summarised the different views which have been based on examinations of mature inflorescences. For example, he points out that Payer (1857) and Eichler (1875) stated that the inflorescence of *Musa* is a spike, whereas

Bentham et Hooker (1880) in their " Genera Plantarum " stated that the scape of *Musa* protrudes from the centre of the leaves so that the inflorescence is to be interpreted as a long terminal raceme. He also refers to Baker (1893), according to whom the inflorescence is a terminal panicle. Schumann's (1900) opinion is that in the Musoideae the bract arrangement is spiral throughout. In the axil of each bract there are at least three flowers. If the flowers are numerous, they occur in double rows, of which the upper is the older, and its flowers mature earlier than those in the lower row. The individual flowers of the lower row invariably alternate with those of the upper row. Schumann refers to an arrangement of this kind as a serial flower assemblage. Since no solitary flowers are to be found in the axils of the bracts, the inflorescence of *Musa* can in no real sense be called a simple spike. The best designation would be a spadix composed of assemblages of flowers. The designation " panicle ", which Baker applied to the inflorescence of *Musa*, is, according to Schumann, unsuitable, since no branching of the flower-group occurs in the axil of the bract. McLean Thompson also points out that De Wildeman (1908) was the first to use the term hand for the flower-groups. Peterson (1840–44, 1889, 1893) and Rendle (1904) thought that the inflorescence of the Musaceae is simple or compound, the flower-groups being subtended by large spathe like bracts radially arranged in three lines around the peduncle. The same authors also point out that the flowers subtended by each bract may be numerous and spring from the axis of the spike. According to White (1928) the inflorescence of *Musa* is a terminal spike rather than a raceme, as the flower-groups are sessile, and individual flowers are not subtended by separate bracts.

In order to discover the mode of origin of the inflorescence as a whole, and particularly of the flower groups, McLean Thompson (1933) studied the ontogenetic sequence in which the individual flowers arise in the flower-groups of *Musa chinensis* Sweet, *M. textilis* Nee. and *M. ensete* J. F. Gmel. He proposed a hypothesis that the ancestor of *Musa* had an aerial stem, beset with spirally arranged leaves, the modern equivalents of which are the spathes. Cones then appeared in the axil of these leaves.

According to this hypothesis the axillary cones have, in the course of their evolution, become reduced to the hands with which we are familiar in present day species of *Musa*. According to McLean Thompson (p. 12) " if the flowers are considered lateral to the cushion, and the latter is a depressed cone, with its base inserted virtually vertically upon the rachis and its apex directed downwards towards the axil of the bract, the Hand may be a Partial Spike ". Later (p. 13) he says " It is therefore necessary on the hypothesis to consider that the ancestral cone has been modified by depression of its apex so that a low curvature has been effected, that progressive deformation of the cone has occurred by abaxial retardation of growth rate, so that the true apex is merged in the abaxial downward curvature, that ancestral spiral flower formation is still attempted, is realised posteriorly in varying degree, and that progressive sterilization has occurred on the congested anterior surface of the cone ".

The above complicated hypothesis is based on an ontogenetic succession of flower primordia which is completely different from that which was

observed by the present writer in the Dwarf Cavendish banana, in *Musa acuminata* Colla, and in *M. balbisiana* Colla.

The investigation described below lends some support to another hypothesis, mentioned, but simultaneously rejected, by McLean Thompson, according to which the flower-groups are cincinni.

Material and Method

Inflorescence-buds of the Dwarf Cavendish banana, *Musa acuminata* Colla., and *M. balbisiana* Colla. have been examined, while still so young that they had not emerged from the pseudo-stem. Of the Dwarf Cavendish banana as many as 5, but in the other species only one or two inflorescences have been investigated.

Material of the Dwarf Cavendish banana was supplied by Mr. S. Stoler from the Upper Jordan Valley, Israel, and that of *M. acuminata* and *M. balbisiana* was received from the Imperial College of Tropical Agriculture in Trinidad through the good offices of Sir Geoffrey Evans.

The material was fixed and preserved in formalin acetic alcohol. The young inflorescences were dissected carefully under a binocular dissecting microscope. Each primordial flower-group was placed in a separate small tube and the tubes were arranged in the same sequence as that in which the flower-groups arose in the inflorescence. Their ontogenetic development could then be followed under the binocular dissecting microscope.

Permanent slides have been prepared from one developmental series of flower primordia in the flower-groups.

The whole of each primordial hand was mounted on an excavated slide in polyvinyl alcohol (Metcalfe & Richardson, 1949) and covered with a cover slip.

Drawings of this material have been made by means of a camera lucida attached to one of the 2 eyepieces of the microscope.

More advanced flower-groups with their cushions were used to study the development of the vascular bundles. These young hands were cleared by boiling and preserving in lactic acid (Sporne 1948). In order to dissolve the tannins, which are abundant in special cells accompanying the vascular bundles, even at a very young stage in some species, the material was first boiled for a few minutes in lactic acid then washed to some extent and kept for a few minutes in a commercial sodium hypochlorite solution. After thoroughly washing, the material was again boiled in lactic acid for about 10 minutes, then mounted in the same fluid on excavated slides, covered by cover slips and sealed with a mixture of resin and wax.

The slides were examined with a binocular dissecting microscope as well as with an ordinary monocular microscope.

Drawings were made with a camera lucida fixed to a monocular microscope.

Observations and Discussion

(1) *Succession of the flower primordia in the flower-groups.*

In the Dwarf Cavendish banana the flowers in the flower-groups are arranged in two tangential rows. The succession of the flower primordia in this species has been followed in hands consisting of different numbers

of flowers ; one with 7 flowers in the adaxial, and 5 in the abaxial, row, two hands with 8 flowers in the adaxial, and 6 in the abaxial, row, and two with 9 and 7 flowers respectively. The primordia shown in the illustrations (Fig. I a–i especially in i), where the numbers express the ontogenetic succession, appear to develop from the right to the left, when the inflorescence is viewed from its side with the apex upwards, and almost simultaneously in both rows. The first primordium to arise is that which becomes the extreme right flower of the adaxial row as arranged in mature hands, the second is its neighbour in the same row, the third is that which becomes the extreme right flower of the abaxial row, and afterwards the initiation and development of the primordia continue in alternating sequence, one in the adaxial being followed by one in the abaxial row.

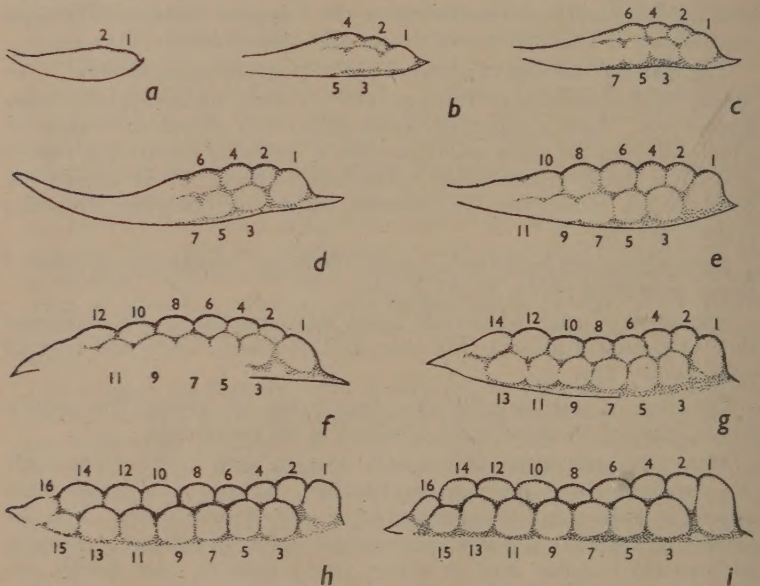


FIG. I, a–i : Different stages in the development of flower primordia as seen in a series of hands from a single inflorescence of the Dwarf Cavendish banana. *a* shows the 19th hand and *i* the 11th hand from the base of the inflorescence, *b–h* representing the remaining intermediate hands.

The numbers indicate the order in which the flower primordia appear.

The figures have been drawn as if the inflorescence was on its side with the apex upwards. 30×.

The very young flower primordia are flattened and their upper surfaces are almost parallel to that of the inflorescence. The primordia of the adaxial row are situated on the top of the cushion and those of the abaxial row are more dorsal, so that, when transverse sections of very young inflorescences are examined, the abaxial row may not be apparent.

An identical ontogenetic succession has also been seen in *Musa acuminata* where the development has been studied in hands with 10 adaxial and 8 abaxial flowers and in *Musa balbisiana* with 9 adaxial and 7 abaxial flowers in each hand. As mentioned above, nearly all the primordia develop in an alternating succession, one in the abaxial being followed by

one in the adaxial row, but those of the first two flowers are exceptional because both of them occur in the adaxial row. If however very young stages in the development of the hand are carefully studied the first primordium seems to belong to the abaxial row (Fig. I a–d) and its position becomes changed only as result of pressure exerted by the growing hand on the adhering bract, whereby it is secondarily transmitted to the adaxial row (Fig. I e–i).

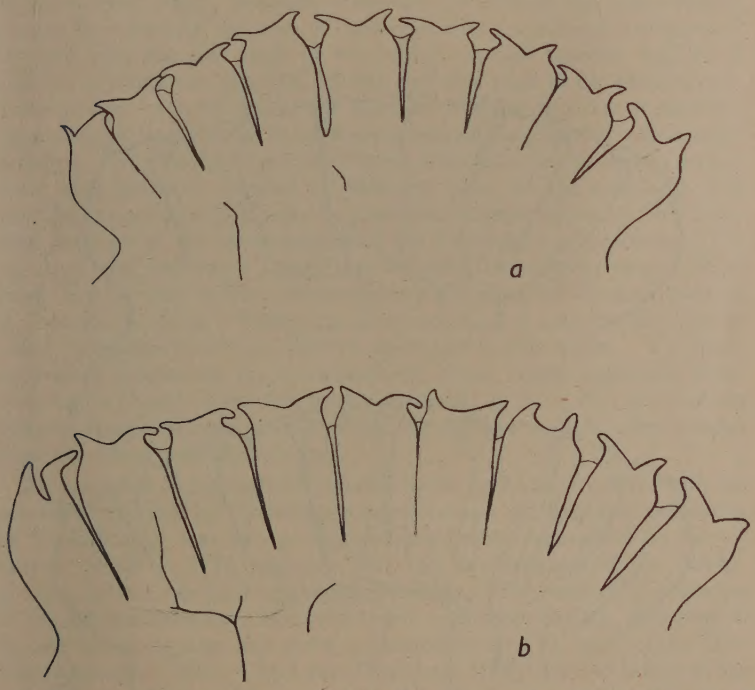
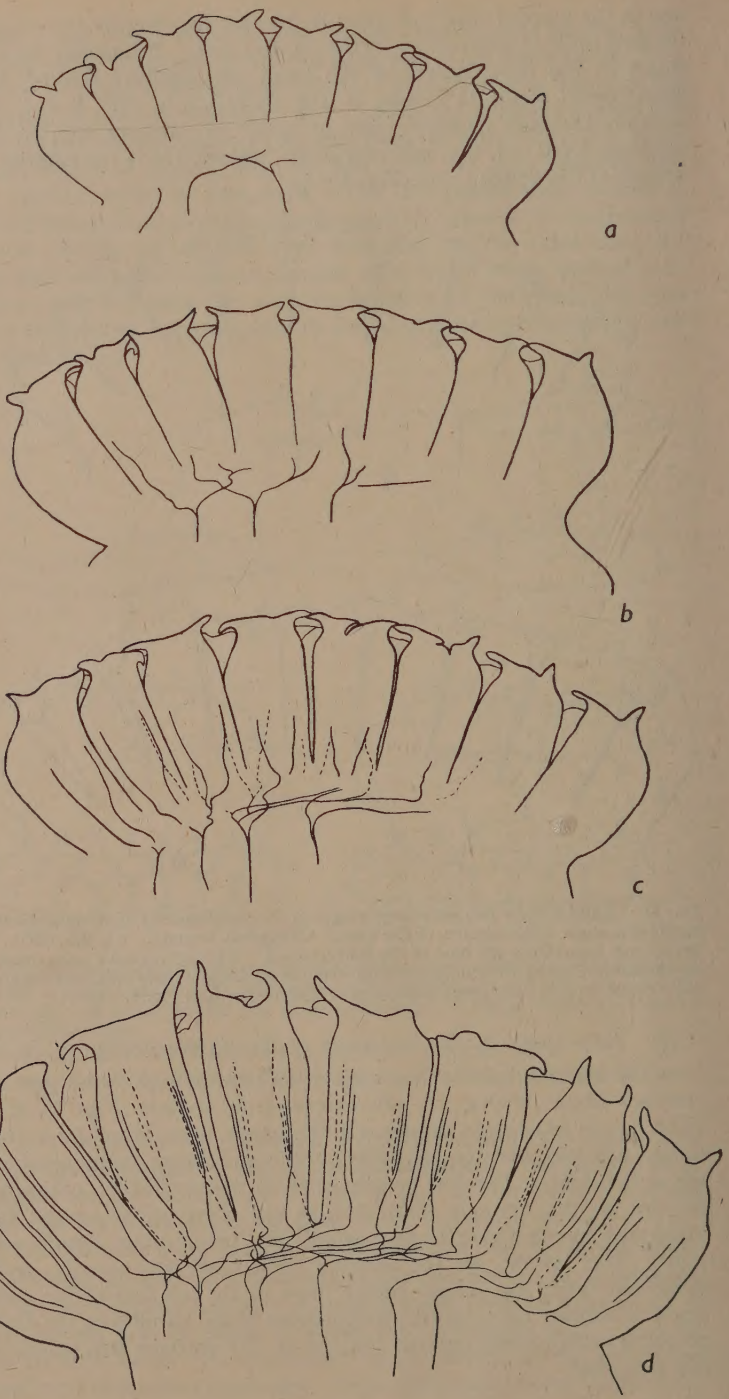


FIG. II : *a* and *b* show two very early stages in the development of vascular bundles in hands of a single inflorescence of the Dwarf Cavendish banana. *a* is the fourth, and *b* the second, hand from the base of the inflorescence. The figures have been drawn as if the hands were being viewed from the direction of the inflorescence axis, and the arrangement of the flowers is therefore the converse of that shown in Fig. I. 15×.

(2) *Early stages in the development of the vascular bundles in the hands.*

The vascular bundles first appear towards the right hand part of the cushions when viewing the inflorescence from its side (Figs. II & III). (The figures have been drawn as if the hands were faced from the inflorescence axis, and therefore the bundles are shown bending from the left to the right). The first bundle of all to appear in the cushion is not the one on the extreme right, but, as my observations on the Dwarf Cavendish banana have shown, usually the penultimate bundle on the right. The bundle on the extreme right hand side usually develops somewhat later, but always before those in the left half of the cushion begin to appear. Later on the development of the bundles in the cushion proceeds progressively towards the one on the extreme left, which is the last to appear.


a
b
c
d

Almost all of the bundles in each cushion supply two or more flowers belonging to both rows. Whilst the branches of the vascular bundles of the cushion are beginning to enter the flowers, separate vascular bundles are laid down in the flowers themselves and subsequently fuse with the vascular strands from the cushion.

As already mentioned, every bundle in the first or primary series to be laid down in any one cushion (with the possible exception of the bundle on the extreme right), becomes connected at the distal end with vascular strands from both of the rows of flowers of which the hand is composed. We can thus see that each of the initial vascular bundles supplies 2 flowers, of which one is in the adaxial, and the other in the abaxial row. Subsequently each of the initial vascular bundles becomes connected, by additional branches, to other flowers besides the pair that was initially supplied. In consequence every flower eventually has vascular connections with primary bundles in different parts of the cushion. The vascular connections gradually become more numerous and form a complex network as the development of the flower-groups proceeds. The fact that the individual flowers are supplied by vascular strands from more than one part of the cushion makes it necessary for the distal parts of the bundles to lie in a horizontal position, which is also the direction in which the parenchymatous cells are orientated in this region. The main impression created by the comparatively young stages, especially those seen in the Dwarf Cavendish banana (Fig. III b–d), is that the cushion bundles appear to bend laterally from the right to the left, when viewed from the side of the inflorescence.

This position of the vascular bundles in the cushions, together with the evidence provided by the ontogenetic succession of the flower primordia in the hands, as was also previously very briefly mentioned by Baumgartner (1913 p. 277), suggests, that the development of the flower-groups of *Musa* can be interpreted as follows. The individual branches of the inflorescence have been shortened, pushed to the left, and pressed by the bracts against the main inflorescence axis to which they have finally become adnate. McLean Thompson (1933) tries to interpret the inflorescence of the other genera of the Scitamineae using *Musa* as a starting point. Certain facts, however, such as the absence of bracts to the individual flowers, and the commonly unisexual nature of the flowers themselves, indicate that the inflorescence of *Musa* has probably already passed through more evolutionary changes than the inflorescence in other related genera. It would therefore appear to be more reasonable to try to interpret the morphology of the *Musa* inflorescence by comparing it with related genera in which the inflorescence is less specialized.

The flowers in mature inflorescences of *Ravenala*, *Strelitzia* and *Heliconia* are arranged in cincinni (Schumann, 1900). The ontogenetic observations described in this article show that the succession of flowers in the hands of *Musa* is similar, but, unlike those of *Musa*, the cincinni of the

Only the upper part of the cushion represents the axis of the adnate branch.

←Fig. III : *a–d* represent four early stages in the development of vascular bundles in hands from a single inflorescence of the Dwarf Cavendish banana. *a* has been drawn from the 8th, *b* from the 7th, *c* from the 6th and *d* from the 5th, hand from the base of the inflorescence.

The drawings have been made from the same point of view as those in Fig. II. 15 ×
The vascular strands drawn with broken lines belong to the flowers of the abaxial row.

genera that have just been mentioned are more elongated and not adpressed and adnate to a main inflorescence axis.

All of the facts that have been brought together appear to support the hypothesis that the flower-groups of the *Musa* inflorescence have developed from cincinni and that the whole inflorescence consists of an axis bearing spirally arranged primary bracts with a cincinnus in the axil of each bract. Holttum (1950) gives a similar explanation of the inflorescence of the Zingiberaceae, another family of the Scitamineae. His paper (p. 7) includes the following significant statement. " It seems fairly clear that a similar type of inflorescence, variously branched and with the ultimate branch-systems cymose, is primitive in the Liliflorae ; and it is evident that the Scitamineae arose from a Liliflorous stock ".

Summary

The development of the primordia of the flowers in the flower-groups has been examined in the Dwarf Cavendish banana, in *Musa acuminata* Colla., and in *Musa balbisiana* Colla. The development of the vascular bundles in the cushion and flowers has also been investigated. From these observations it has been concluded that the flower-groups of the banana plant have developed phylogenetically from cincinni which have been shortened, pushed to the left, and pressed by the bracts against the main inflorescence axis to which they have finally become adnate.

Acknowledgment

The author wishes to thank the Director of the Royal Botanic Gardens, Kew, for the hospitality extended him while he was carrying out this work in the Jodrell Laboratory. He is particularly grateful to Dr. C. R. Metcalfe for his valuable suggestions and criticism in connection with this paper. The author is also indebted to Mr. S. Stoler, Sir Geoffrey Evans and the Imperial College of Tropical Agriculture for providing the plant material. Finally he would like to thank Dr. E. E. Cheesman for advice concerning the use of the name " the Dwarf Cavendish banana ".

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SOME WEST INDIAN GASTEROMYCETES.

R. W. G. Dennis.

In the autumn and winter of 1949 the writer made a small number of Gasteromycete collections in Trinidad, Venezuela and Jamaica. It is hoped that a brief account of these, supplemented by a number of others received at Kew from the same region, will be helpful to West Indian mycologists and will stimulate study of these fascinating plants on the spot.

PHALLALES

Dictyophora *Desvaux* Journal de Botanique **2,** 88 (1809).

Dictyophora indusiata (*Ventenat ex Persoon*) *Desvaux* op cit., 92.

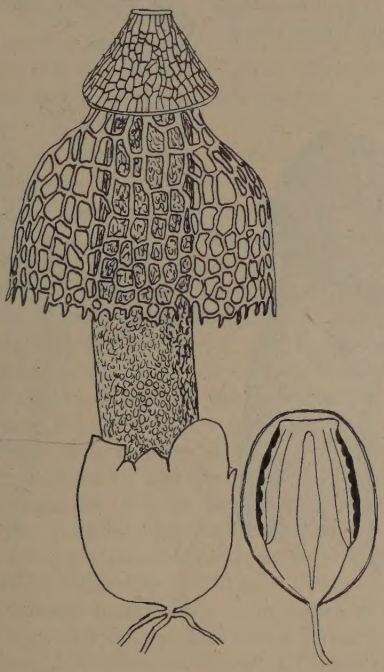

Fig. 1. *Dictyophora indusiata* mature fructification and section of egg × ⅔.

This is the common phalloid of Trinidad. Cunningham (1944), following Lloyd (1909), distinguishes it from *D. duplicata* (Bosc) E. Fischer of North America by the rugose reticulate markings of the pileus as against more regular reticulation in the latter. The Trinidad material has a pileus closely resembling that of *Phallus impudicus* Pers., hence more like that of *D. duplicata* as figured by Smith (1951) than that of *D. indusiata* sensu Cunningham. It matches exactly, however, Möller's figure of *D. phalloidea* Desvaux in Brazil, cited by Cunningham as *D. indusiata* and also agrees with the latter species in its deep, widemeshed, wide spreading indusium. The common form in Trinidad has a white stipe and in-

dusium but a single specimen with these organs pale pink was collected in the forest at Quinam. Fig. 1.

Collections seen : White form, St. Augustine, 20.X.1949 ; St. Joseph November 1949, Dennis 460; St. Augustine 26.IV.1947, R. E. D. Baker 1470. Pink form, Quinam 4.XI.1949, Dennis 284.

Itajahya *Möller* in Schimper's Bot. Mitt. Tropen **7,** 148 (1895).

Itajahya galericulata *Möller* op. cit.

This odd little phalloid has been fully redescribed by J. E. Wright (1949a) from Argentine material. Superficially it much resembles a small state of *Phallus ravenelii* Berk. et Curt. but differs fundamentally in the structure of the pileus. In *Phallus* this is a simple membrane bearing wrinkles or ribs on its outer surface. In *Itajahya* the pileus is composed of spongy tissue about 5 mm. thick. Fig. 2.

FIG. 2. *Itajahya galericulata* from Jamaica, natural size ; section of egg from Argentine material kindly supplied by Dr. Jorge Wright.

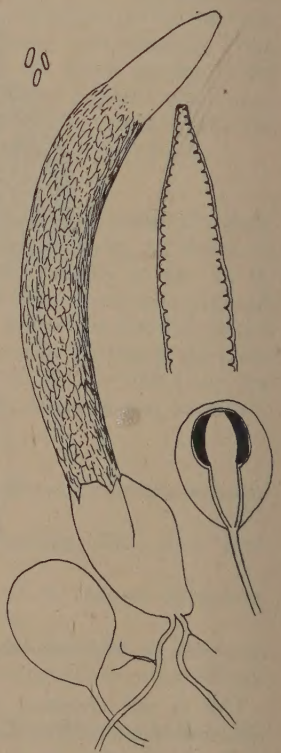

FIG. 3. *Mutinus bambusinus,* Dennis 90, mature fructification and egg, sections of apex and of egg, natural size ; spores × 660.

The species has already been reported from Texas, Arizona and New Mexico (Long & Stouffer 1943) so its occurrence in Jamaica is not unexpected. Sultan Ahmad (1945) regarded a similar but usually pink fungus common on the Punjab plains as a form of this species and adopted

for it the name *I. rosea* (Delile) Fischer. It is apparently the pink form that Malençon (1953) finds in Morocco.

Collections seen, sent in formalin from Jamaica : on lawn, Ellesmere Rd., St. Andrews, *C. Lawrence* 17.I.1948 ; Kingston, *F. Shaw & A. Barry*, 28.VIII.1945.

Mutinus *Fr.* Summa Veg. Scand. pt. 2, 434 (1849).

Mutinus bambusinus (*Zoll.*) *Ed. Fischer* in Ann. Jard. Bot. Buitenzorg **6,** 30 (1887).

Egg ovate, white, smooth, 17–22 × 13–15 mm., seated on a white cord-like mycelium. Receptacle cylindric-fusoid, about 90 × 8–9 mm., the sterile portion pale pink, the fertile portion carmine, smooth, 17–27 mm. long, only slightly delimited from the sterile portion, tapering gradually to a blunt apex ; flesh constructed throughout of a single layer of chambers, uniform in size and open on the inside, closed on the outer surface by a continuous membrane. Gleba olivaceous, not covering the apex of the receptacle in the egg, smell pungent and penetrating but not offensive ; spores rodshaped 3·5 × 1–1·5μ.

Collection seen : Trinidad, under bamboos, River Estate, Diego Martin, 29.IX.1949, *Dennis* 90. Fig. 3.

The species of *Mutinus* are delimited with difficulty, largely because it is far from clear which characters are constant and dependable. From the common north temperate species *M. caninus* (Pers.) Fr. the Trinidad fungus differs not only in colour and smell but in the simpler structure of both sterile and fertile parts of the receptacle, which are alike only one chamber thick. Typical *M. bambusinus* is said to differ in the chambers of the sterile base being perforate to the outside instead of to the inside as here. It should also have minute parenchymatous processes on the fertile part, supporting the gleba and a small sterile tip. On the other hand *M. muelleri* Ed. Fischer, from Brasil, as illustrated in Möller's photograph appears remarkably like Dennis 90 and both Möller himself and Petch (1926) regarded this as inseparable from *M. bambusinus*. Petch showed that the processes on the fertile portion varied greatly in development and might be almost absent from small specimens. According to the key offered by Bottomley (1948) the Trinidad fungus would be *M. simplex* Lloyd, hitherto known only from South Africa, but Lloyd's figure shows a much stouter fungus and seems unlikely to represent the same species as mine. According to Coker & Couch (1928) and Smith (1951) the common north American *M. curtisii* (Berk.) Ed. Fischer has much larger spores, 4–7 × 2–3μ.

How far the alleged differences from *M. bambusinus* are good and constant can only be decided by observation of a long series of fresh specimens and in the meantime I propose to regard Dennis 90 as a small state of that cosmopolitan species.

Laternea *Turpin* 1822, emend. Linder in Ann. Miss. Bot. Gard. **15,** 110 (1928).

Linder has shown that the characteristic feature of this genus is the " lantern " suspended from the apex of the columnar receptacle and stressed by Turpin in his original diagnosis.

Laternea triscapa *Turpin* in Dict. Sci. Nat. **25,** 248 (1822).

The type collection was from the isle of Tortuga, off Haiti, where it grew on plant debris in the shade of forest trees. The Trinidad material has a deep orange lantern with three supporting arms which are concolorous at the tip, paling rapidly to almost white at the base. Spores measure 4–5 × 1μ.

Collection seen : Trinidad, under bamboo, River Estate, Diego Martin, 29.IX.1949. Fig. 4.

Fig. 4. *Laternea triscapa* fructification natural size, spores × 660.

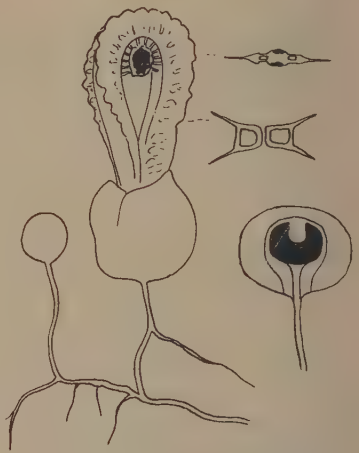

Fig. 5. *Laternea pusilla*, fructification with transverse sections of the receptacle at the levels indicated and vertical section of egg, all natural size.

Laternea pusilla *Berk. et Curt.* in Journ. Linn. Soc. Bot. **10,** 343 (1869).

This species, hitherto known with certainty only from the type collection of two sporophores from Cuba, at Kew, was excluded from *Laternea* by Linder on the ground that it lacked the characteristic apical lantern. Linder apparently had not seen the type and probably based his opinion on the fairly representative photograph of it published by Lloyd (1909). Careful examination of the type shows, however, that it does carry the typical lantern of *Laternea* and is a good species of that genus. As the published diagnosis is sadly inadequate a full description of the recent Jamaican collection is given below. Patouillard (1903) recorded *L. pusilla* from Martinique and Guadeloupe but from his description it is not quite clear whether he had this or *L. triscapa*.

Mycelium white, of much branched strands about 1 mm. thick, ramifying amongst lichens and loose humus. Unexpanded sporophores, "eggs", globose, pure white, borne singly at the end of mycelial strands, up to 1·6 cm. diameter at maturity. Peridium thin, enclosing colourless jelly of the volva 3–4 mm. thick. Receptacle formed of two columns 3–4 mm. wide, united to the peridium at the base, diverging above to surround the lantern and fused at their apices, pale ochraceus, their surfaces pitted and cellular. In cross section the columns are quadrangular and hollow below, their outer edges each adorned by a thin serrated crest,

but circular and solid above, where the two crests of each column fuse to form a single slender ridge. Lantern deep orange, about 3–4 mm. broad and deep, longitudinally furrowed, suspended from the apex of the columns by numerous short trabeculae. Gleba blackish green, coating the lantern only. Spores measure 3–4 × 1–1·5μ. Fig. 5.

Collection seen : Jamaica, amongst *Cladonia* on the ground between Sir John and High Peaks, Blue Mountains, *Mrs. Hutchinson*, 22.XII.1949, J44.

Blumenavia *Möller* in Schimper's Bot. Mitt. Tropen **7,** 146 (1895).

Blumenavia rhacodes *Möller* op. cit., 147.

The Trinidad collection differs from the type in having the receptacle white throughout instead of being " hell gelb ". As considerable variation in colour is not uncommon amongst phalloids there need be little hesitation in referring it to the same species. A full description drawn up from the fresh material is appended.

Mycelium cord-like, white, egg subglobose, externally grey. Receptacle composed of three stout arms, tapering upwards and firmly united at their apices, white ; outer face corrugated transversely, sometimes cracking down the middle but not regularly longitudinally furrowed, chambers of the flesh not exposed ; inner face of each arm marked by two longitudinal furrows and by transverse corrugations. The angle between the inner and outer faces is marked by a row of pointed teeth. Gleba dark olive-green, adhering to the inner face of the arms. Spores rod-shaped, 3 × 1μ, hyaline. Smell foetid. Fig. 6.

Collection seen : Trinidad, on trail through rain forest, 1800 ft. on Naranja, Northern Range, 2.X.1949.

Linderiella columnata (Bosc) G. H. Cunningham, said to be common in the West Indies, differs in its three or four orange or scarlet arms being detached from the volva. They appear to be of a much spongier texture and more clathroid than those of *Blumenavia*.

Clathrus *Micheli ex Persoon* Syn. Method, Fung. 241 (1801).

Clathrus crispus Turpin in Dict. Sci. Nat. Atlas, t. 49 (1820).

To this old West Indian species I refer a collection sent in formalin from Jamaica, which agrees closely with Lloyd's figure of *C. pseudocrispus* from Montego Bay in the same island. In 1909 he stated this to be " probably only a form of *Clathrus crispus* " and in 1916 he definitely reduced it to synonymy under that species. The difficulty in identification arose from the perfectly globose character of the receptacle in Turpin's figure and its large number, apparently about 70, of small, perfectly regular, meshes. It seems fairly clear, however, that this figure is somewhat idealised. Brongniart (1823) cited under *C. crispus* the much cruder but perhaps more characteristic figure of an obovate receptacle published by Plumier (1705) under the name *Boletus cancellatus, purpureus*. He was followed in 1842 by Berkeley, who described as *C. crispus* var. β *obovatus* some *Clathrus* with obovate receptacles collected by Darwin on sand dunes at Maldonaldo, Uruguay in May and June

1832. According to Cunningham (1944) similar variation in shape and an occasional tendency to a columnar arrangement of the basal part of the mesh occurs in *C. cibarius* (Tul.) E. Fischer. Turpin's figures appeared without a diagnosis but are detailed enough to constitute valid publication of the name under Article 44 of the International Rules of Nomenclature.

In 1916 Lloyd announced that his *C. americanus*, described in 1909 from Brazil and the Bahamas, must also be regarded as a state of *C. crispus*.

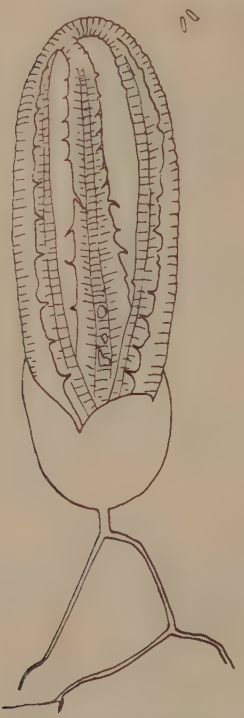

Fig. 6. *Blumenavia rhacodes*, fructification natural size, spores × 660.

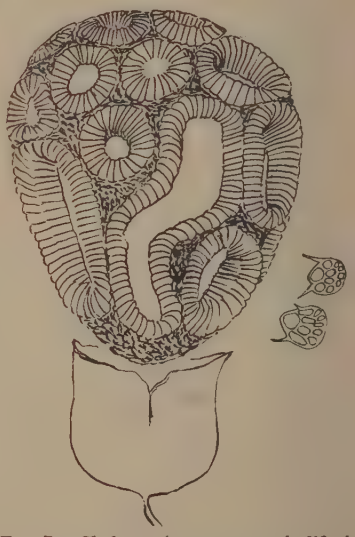

Fig. 7. *Clathrus crispus*, receptacle lifted clear of the volva and sections of arms × ⅔.

Ulbrich (1950), however, has redescribed *C. americanus* Lloyd from Cuban material and emphasised the presence in it of a stalk-like base raising the meshwork above the volva. This is not present in the Jamaican collection here referred to *C. crispus*. Wright (1949b) treated *C. americanus* as a small variety of *C. crispus*.

The distinctive feature which at once separates *C. crispus* from the north temperate species *C. ruber* Mich. ex Pers. is the broad corrugated rim which surrounds each mesh of the receptacle and leaves very little spongy tissue exposed, especially in the upper half of the sporophore.

Collection seen : Jamaica, on earth near an old stump, Lady Musgrave Rd., St. Andrew, *A. Barry*, 27.VIII.1945. Fig. 7.

Clathrus cf. **chrysomycelinus** Möller in Schimper's Bot. Mitt. Tropen **7,** 146 (1895).

Mycelium white, cord-like, volva subglobose, slightly flesh-coloured, smooth. Receptacle obovate, white, formed of rather narrow bars 3–4 mm. wide, surrounding large polygonal meshes, outer surface minutely pitted. Gleba olivaceous, adhering to the inner surface of the receptacle, spores yellowish, rod-shaped, 4–5 × 1·5–2μ. Sections of the receptacle show it to have a coarsely chambered structure, with one central elongated chamber surrounded by a ring of about 5 outer chambers.

Collection seen : Jamaica, at about 4000 ft., Clydesdale, 19.XII.1949, *Dennis* J 10.

From typical *C. chrysomycelinus* this collection differs in its mycelium being white instead of yellow and probably in the meshwork not becoming columnar towards the base. According to Lloyd (1909) however, " Father Schupp finds it " (in Brazil) " and he writes me the mycelium is not always yellow ".

It is desirable that further collections of the Jamaican form be made and studied in the fresh condition to determine how far the differences indicated above may be constant.

C. cibarius (Tul.) E. Fischer of Australasia looks very similar but according to Cunningham its receptacle is loose from the volva and is commonly blown about by the wind. The receptacle of the Jamaican collection was far too brittle to behave in this way, it did not even survive intact the short journey from Clydesdale to Cinchona on the day of collection.

Colus hirudinosus *Cav. et Sech.* in Ann. Sci. Nat., Ser. 2, **3,** 253 (1835).

Mycelium cord-like, white, bearing numerous sporophores. Unexpanded volva globose, 1 cm. diameter, white, mottled with brown above. Receptacle united below, soon divided into 3–5 arms, tapering upwards and there reunited to carry a small apical meshwork about 5–7 mm. wide with very small perforations. Receptacle pink below, shading to deep red above, externally smooth, the sides of the arms and holes of the meshwork closely corrugated. One specimen has a regular arrangement of 3 arms, each forked to give 6 in the upper half which carry a flat apical plate perforated by 5 holes but this symmetrical branching is not seen in any other sporophore on the same mycelium. Gleba olivaceous, filling the cavity of the receptacle in the egg state, then carried upwards on the under side of the apical mesh and along the inner surface of the arms. Spores rod-shaped, hyaline, 3·5–6·5 × 1–1·75μ. Smell strong and rather fish-like. Fig. 8.

Jamaica, on rotting branches on the ground in forest, hillside above the trail to Morce's Gap, Blue Mountains, 25.XII.1949, *Dennis* J 61.

This beautiful little phalloid differs markedly from most published figures of *C. hirudinosus* in the small size of its apical lattice. Reference to Cavalier & Sechier's careful figures of the type collection from Toulon shows, however, that in this the apical meshwork was very like that of

J 61, though they indicate 17 perforations (Fig. 8). In a Swiss collection described by Benzoni (1943), under the name " *C. hirondinosus* Cav. " the spores are said to have been 6–7 × 3–4μ, i.e. elliptical rather than rod-shaped. On the basis of these differences one might feel justified in treating the Jamaican fungus as a distinct variety or even a new species. But in Australian material Cunningham found the spores to be 5–6 × 1·5–2μ and in view of the known wide variability of other phalloids it seems best at present not to propose a new name based on but a single collection. In stature it recalls *C. garciae* Möller from Brazil but that was white and the arms " an der Spitze nur in einem Punkte verbunden sind ", like those of *C. javanicus* Penz.

Fig. 8. *Colus hirudinosus*, left : Jamaican material ; right : part of Cavalier & Sechier's figure of the type collection. Fructifications natural size, spores × 660.

HYMENOGASTRALES

Protubera *Möller* in Schimper's Bot. Mitt. Tropen **7,** 145 (1895).

Protubera maracuja *Möller* op. cit.

This species has been well described by Möller from Brazil, by Petch (1911) from Ceylon and by Boedijn (1932) from Sumatra. It occurs on the soil surface, amongst litter on the forest floor. The unbroken peridium resembles an egg of a phalloid but tends to be elongated horizontally instead of vertically. It may be 7 cm. in diameter, smooth, vinaceous buff to cinnamon buff, and arises from a white cord-like mycelium. A vertical section discloses three concentric tissues, the white peridium about 1 mm. thick and very tough, a gray gelatinous layer about 4 mm. thick and the olive-green gleba, divided into chambers by plates of whitish, more or less gelatinous tissue, radiating from an area above the point of attachment to the mycelium. Very thin plates of white tissue traverse the gelatinous layer and unite peridium and gleba. They may be so thin as to be scarcely discernable in the vertical

section but are easily seen in a tangential slice through the peridium and its underlying gelatinous layer. The spores measure 3·5–4 × 1·5–1·75μ. At maturity the peridium splits irregularly exposing the gleba. Ultimately only the empty torn peridium remains, still anchored to the soil by the mycelial strand. Its white inner surface bears an imperfect network of ridges indicating the position of the mycelial plates which permeated the gelatinous layer. Petch noted a smell of rotting oranges, Möller one of passion fruit.

Collection seen : Jamaica, in forest at 5000 ft. near Morce's Gap, Blue Mountains, 20.XII.1949, *Dennis* J 31.

Protophallus jamaicensis Murrill 1910 seems very similar to the above and was described from the same locality. The fructifications of its type collection are, however, smaller and more spherical and have a much more strongly developed columella. Zeller (1939), whose opinion cannot lightly be rejected, considered *Protubera* & *Protophallus* separable on the latter character, with the columella branched from near the base in *Protubera* and extending to the centre of the fruit body before branching in *Protophallus*. The distinction seems somewhat precarious but if it be valid J 31 is referable to *Protubera*.

PODAXALES

Podaxis pistillaris (*L. ex Fr.*) *Fr.* Syst. Myc. **3,** 62 (1829).

A full description of this cosmopolitan fungus is easily accessable in Morse (1933) who cited a Jamaican collection in the Farlow Herbarium.

West Indian collection seen : Jamaica, on sand by the seashore, Palisadoes, Port Royal, *Amy Barry*, 26.VIII.1944.

Fig. 9. *Geastrum hariotii*, peridium and peristome seen from above, natural size, spores × 1300.

LYCOPERDALES

Geastrum *Persoon* Syn. Meth. fung. p. 131, 1801.

1. **Geastrum hariotii** *Lloyd*, Mycological Notes **24,** 311 (1906).

Exoperidium completely coated by a mycelial weft adhering to the substrate, about 1·5mm. thick, splitting into 5–8 rays and then strongly

recurved, often cracking across the base of the rays, inner surface avellaneous, drying bister. Endoperidium subglobose, sessile, slightly flattened above, minutely warted, olive-buff, drying bister, peristome darker than the endoperidium, strongly sulcate with up to 25 furrows, about 4 mm. high. Gleba fuscous. Capillitium of straight, rough, dark brown threads 2·5–4μ wide. Spores very dark brown, globose, 3μ diameter, with a central oil drop, surface minutely warted. Fig. 9.

Collection seen : Trinidad, under bamboos, St. Joseph, 18.X.1949, *Dennis* 188.

The species is evidently widespread in tropical America ; Coker & Couch (1928) cite specimens from Porto Rico, British Honduras, Surinam and Brazil.

2. **Geastrum lloydii** *Bresadola* in C. G. Lloyd, Mycological Notes **6,** 50 (1901).

Fig. 10. *Geastrum lloydii*, on left, peridium freed from the mycelial layer and hanging by the mycelial strand ; centre, peridium almost freed from the mycelial layer, which adheres firmly to the substrate ; right, unopened peridium, all natural size. Spores × 1300.

Unopened peridium subglobose with a tawny coating of stiff, somewhat tufted, hair-like mycelium which at maturity becomes firmly attached to the substrate or adjacent litter. Exoperidium splitting into 5–8 rays, then separating completely into a thin papery outer layer which adheres to the substrate and a fleshy inner layer about 1 mm. thick, which becomes arched and lifts the endoperidium. The split commences in the centre of the base and spreads outward to the tips of the rays. Ultimately the inner layer of the exoperidium with the endoperidium attached becomes completely free from the outer layer but remains anchored to the substrate by a white mycelial cord, about 2 cm. long. The inner surface of the fleshy layer of the exoperidium is ochraceous buff, often cracked, and becomes mummy brown when dry. Endoperidium globose, sessile, seated in a shallow cup of exoperidium, very minutely downy, drab, drying mummy brown, mouth rather wide, peristome not defined by a furrow, concolorous, fimbriate. Capillitial threads straight, dark brown, rough, 2·5–5μ thick. Spores globose, dark brown, 3–3·5μ diameter, very slightly rough, containing an oil drop. Fig. 10.

Collection seen : Trinidad, in swarms on pockets of soil in crevices of trunk and roots of *Ficus benjamina*, Botanic Gardens, Port of Spain, 11.XI.1949, *Dennis* 319.

The type collection was from Samoa ; Coker and Couch (1928), whose interpretation of the species is followed here, recorded it from Florida and Porto Rico. Its distinctive characters are the very coarsely hairy outer surface of the peridium, the complete splitting of the exoperidium into two layers from the center outwards and the curious mycelial cord which anchors the inner exoperidium and attached endoperidium after they have split off.

The small spores of the Trinidad collection may suggest an approach to *G. hieronymi* Hennings 1897 but the endoperidium is nowhere "harshly asperate with short setose hairs" as in that species.

3. **Geastrum pectinatum** *Persoon*, Syn. Method. Fung., 132 (1801).

Exoperidium completely covered by a layer of loosely woven hyphae, binding fragments of soil or debris to its entire surface, splitting into about 6 rays and then everted so as to lift the endoperidium on a convex star-shaped base, inner surface cream-coloured when dried. Endoperidium seated on a cylindrical stalk 5 mm. long, globose, dark gray with a whitish bloom, ornamented at the base by ridges and furrows radiating from the top of the stalk. Mouth conical, deeply sulcate, dark brown. Capillitial threads undulating, rough, dark brown, about 5μ thick. Spores globose, brown, 4 4·5μ diameter or 5·5–6·5μ including the very coarse warts.

Collection seen : Cuba, *Wright* 694.

This collection was published by Coker & Couch (1928) as *G. Schmidelii* Vitt. They agree, however, that this differs from *G. pectinatum* mainly in its smaller size and that intermediates occur. Cunningham (1944) feels unable to separate these two species.

I have not seen the type of *G. involutus* Massee, from San Domingo, referred by Coker & Couch to *G. drummondii* Berk., an Australian species with hygroscopic rays and conical sulcate mouth.

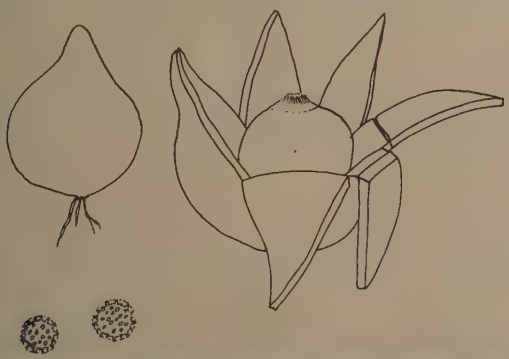

FIG. 11. *Geastrum saccatum*, unopened and newly opened peridia, natural size, spores × 1300 all from Dennis 199.

4. **Geastrum saccatum** *Fr.*, Syst. Myc. **3,** 16 (1829).

Unopened peridium shaped like a tulip bulb, with prominent rounded beak, surface ochraceous buff, finely felted or scurfy, attached to a rather fibrous white mycelium. Exoperidium about 2 mm. thick,

splitting into 5–8 rays which may crack at the base but do not become recurved or raise the peridium from the ground, lower portion permanently bowl-shaped, inner surface smooth, pale ochraceous-buff to drab gray, drying bister. Endoperidium globose, sessile, drab gray, mouth fimbriate, surrounded by a pale shining zone. Capillitial threads undulating, yellowish to brown, rough, 2–5μ wide. Spores globose, brown, 2·5–3·5μ diameter, rather coarsely warted. Fig. 11.

Collections seen : Trinidad, Non Pareil, Sangre Grande, 19.X.1949, *Dennis* 199 ; on forest floor, Cerro del Aripo, 23.X.1949, *Dennis* 199B ; Jamaica, Cinchona, Blue Mountains, Dec. 1949 ; Cuba, *Wright* 690, 692, 688, 870, 248 determined by Berkeley as *G. fimbriatum* ; Venezuela, Rancho Grande, Maracay, leg. J. Standen.

This species is very near the cosmopolitan *G. triplex* Jungh., which Cunningham separated on the basis of its larger spores, 4–5·5μ diameter. British material referred to *G. triplex*, however, has spores only 3·5μ diameter, excluding the fine warts. The distinction from *G. saccatum* would thus seem to lie mainly in the larger size of *G. triplex* and the tendency to longitudinal cracking of its exoperidium.

5. **Geastrum velutinum** *Morgan* in J. Cincinnati Soc. Nat. Hist. **18,** 38 (1895).

This is said to differ from *G. saccatum* in the absence of a beak on the unopened peridium and in the looser, better developed, outer fibrous layer of the exoperidium, which tends to strip off the rays. To it may be referred a single Trinidad collection with peridia larger than those referred to *G. saccatum*, with much more loosely tomentose outer surface, a less prominent halo round the mouth and less coarsely warted spores.

There is a distinct tendency to separation of the outer mycelial layer of the rays. Unfortunately this collection included no unopened peridia.

The species may be expected to occur throughout the West Indies and Patouillard has recorded several collections from Guadeloupe and Martinique under the name *Cycloderma ohiense* Cooke & Morgan.

Collections seen : Brasil, Bom Jardim, Jan. 1904, Rick, Fungi austro-americani 13 ; Guadeloupe, Pointe Noire, 20.I.1897, *Duss* 158 ; *Duss* 1839, 1900, all in Herb. Farlow ; Trinidad, River Estate, Diego Martin, 30.IX.1949, *Dennis* 99B.

6. **Geastrum mirabile** *Mont.* in Ann. Sci. Nat. Ser. 4, **3,** 139 (1855).

Peridia gregarious on a continuous sheet of white mycelium overrunning the substrate, usually sticks and fallen leaves. Unopened peridia subglobose, at first white, soon becoming ochraceous buff, tomentosely fibrillose. Exoperidium about 1 mm. thick, splitting into 6–7 slightly recurved lobes, lower portion permanently bowl-shaped, enclosing the endoperidium, inner surface pale cinnamon pink to pinkish buff, drying gray-brown and papery. Endoperidium drab, drying mouse gray, minutely pubescent, mouth area at first white but soon darkening, mouth fimbriate. Capillitial threads undulating, rough, dark brown, 1–2μ wide. Spores spherical, dark brown, 3μ diameter, minutely warted. Fig. 12.

Collections seen : Trinidad, watershed at River Estate, Diego Martin, Sept. 1949, Dennis 99A ; on a termite nest under *Bactris*, Quinam, 4.XI.1949, Dennis 99C ; Venezuela, Rio Chacaito, Caracas, 18.XI. 1949, *Dennis* 99D ; Cuba, on rotten wood in shady forests, Feb. *Wright* 696 ; ad lign. Junio-Feb. *Wright* 695 ; *Wright* 246 ; British Guiana, Moraballi Creek near Bartica, Essequibo river, 6.IX.1929 *P. W. Richards* 336 ; Paraguay, sur les debris de nid de termite, 24.VII.1883, *Balansa* 3903.

Geastrum subiculosum Cooke et Massee, recorded from Jamaica is similar in habit but slightly larger, with smooth spores 2–3μ diameter.

Fig. 12. Left : *Geastrum mirabile*, peridia on the subiculum, natural size, spores × 1300. Right : *G. trichifer* from British Guiana.

7. **Geastrum trichifer** *Rick apud Lloyd* in Mycological Writings **2,** 314, 1907.

This differs from *G. mirabile* only in the erect fasciculate hairs 1 mm. long on its exoperidium. Rick later concluded it not to be distinct but Lloyd retained it, as did Coker & Couch, who recorded material so referred from Jamaica. Fig. 12, right.

Collection seen : British Guiana, Tiger Creek, Essequibo river, Aug. 1937, *N. Y. Sandwith.*

Geastrum coronatum (Schaeff.) Schroet., recorded from Jamaica, is a fornicate species with fimbriate mouth. There is no material so referred from the West Indies at Kew.

Calvatia *Fr.* in Summa Veg. Scand. 2 p. 442, 1849.

This is a genus of large puffballs, separated from *Lycoperdon* by the upper part of the exoperidium flaking away to expose the gleba.

Calvatia lilacina (*Mont. et Berk.*) *P. Henn.* in Hedwigia **43,** 205 (1904).

Bovista lilacina Mont. et. Berk. in Hooker's London Journal of Botany **4,** 64 (1845).

Globaria lilacina (Mont. et Berk.) Speg. in Ann. Soc. Cient. Argentina **9,** 187 (1880).

Lycoperdon lilacinum (Mont. et Berk.) Massee in J. Roy. Microscop. Soc., 706 (1887).

Peridium first globose, soon becoming turbinate or pyriform, whitish or pinkish buff with clay-coloured blotches, the upper surface often reticulately cracked into small polygonal areas, finally flaking away to expose the gleba. The lower half of the peridium is occupied by a sterile

base, composed of cream coloured spongy tissue limited above by a well marked diaphragm. Gleba purplish brown. The whole fungus becomes vinaceous drab at maturity, appearing darker when wet. Capillitium smooth or very minutely dotted, thinwalled, 2·5–6μ diameter but somewhat irregular, pale purplish-brown, breaking into short lengths. Spores globose, 4μ diameter, pale lilaceous, finely warted.

Collections seen : Trinidad, in buffalo pasture beside Churchill-Roosevelt highway, S. of Tacarigua, 30.X.1949, *Dennis* 253A ; football field, Tacarigua, 11.X.1949, *Dennis* 253 ; Jamaica, Barbican, St. Andrew, *L. Perkins*, June 1945 ; Brasil, Rio de Janeiro, 1882, *A. Glaziou* 14439A ; Paraguay, dans les campos, Paraguari, Avril 1881, *Balansa* 3318 ; Argentina, in campis aridis, Concepcion del Uruguay, Aest. 1875, *P. G. Lorentz*, de Thumen, Myc. univ. 523.

Lloyd (1904) has shown that *Hippoperdon crucibulum* Mont., from Cuba, was based on the sterile residue of an old *C. lilacina* peridium.

Most American authors adopt for this cosmopolitan species the name *C. cyathiformis* (Bosc) Morgan, based on *Lycoperdon cyathiforme* Bosc 1811. Cunningham rejects this on the ground that no type of the latter exists and the diagnosis is too imperfect for positive identification. *Calvatia fragilis* (Vitt.) Morgan, based on *Lycoperdon fragile* Vitt. 1842, may be no more than a small state of the same species.

Berkeley & Curtis's record of *C. caelata* (Bull.) Morgan from Cuba is an error. The pantropical *C. rubroflava* (Cragin) Lloyd has been recorded from Jamaica by Coker & Couch. There is material at Kew from Brasil but, as yet, none from the West Indies.

Lycoperdon *Tournefort ex Persoon* Syn. Meth. Fung., 138 (1801).

The following key includes those actually seen from the West Indies plus *L. acuminatum* Bosc, a minute species described from Costa Rica and therefore very likely to be found in the Caribbean forests when looked for.

I. Peridia very small, less than 10 mm. diameter, pointed above, growing amongst mosses on living tree trunks . *L. acuminatum* Bosc

II. Peridia larger, rounded above, on logs, forest litter or soil :

A. Spores elliptical . . . . . *L. oblongisporum* B. & C.

B. Spores globose :

1. Peridia without a sterile base or with a very small base without chambers, vinaceous-buff, spores conspicuously echinulate *L. fuligineum* B. & C.

2. Peridia with a well-developed sterile base, spores echinulate, verrucose or smooth :

a. On logs and decayed wood, peridia ± pyriform, usually over 2 cm. diameter, some shade of brown, rough *L. pyriforme* Schaeff. ex Pers.

b. On the ground :

α Exoperidium of conical warts, each surrounded by a ring of minute granules, spores apedicellate :

*Warts cohering at the tip, peridia up to 2 cm. across *L. peckii* Morg.

**Warts separate, peridia usually larger . *L. perlatum* Pers.

β Exoperidium of minute slender spines or granules :

*Spores with a long slender pedicel . . *L. dominicensis* Mass.

**Spores apedicellate :

†Capillitium very thinwalled and hyaline, exoperidium of minute whitish spines . . . . . *L. depressum* Bon.

††Capillitium brown, exoperidium of densely crowded obtuse granules, becoming almost black with age *L. atrum* Pat.

1. **Lycoperdon oblongisporum** *Berk. et Curt.* in J. Linn. Soc. London **10,** 345 (1869).

Peridium subglobose, slightly tapering below, up to 2 cm. diameter. Exoperidium formed of minute scattered granules, interspersed with slender, conical, loosely attached spines, scarcely visible to the unaided eye. Gleba approximately walnut brown, sterile base small but distinct, with minute but quite definite chambers. Capillitial threads much branched, 3–4μ wide, tapering gradually to a slender tip, smooth, undulating, dark brown. Spores elliptical to ovate, dark brown, smooth, 4·5–7·5 × 3μ. On the ground amongst dead leaves. Fig. 13.

Fig. 13. *Lycoperdon oblongisporum*, type collection natural size, exoperidial warts in lens view, spores × 1300.

Collection seen : Cuba, *Wright* 252 (Typus).

The species has also been reported from Guadeloupe by Duss, from North Carolina by Coker & Couch and from Michigan by Smith. Coker & Couch recorded forms with only slightly elliptical spores, showing passage to *L. pusillum*. Smith (1951) finds the two species in the same locality and considers them truly separable on spore characters as those of *L. pusillum* are globose and distinctly echinulate. Perdeck (1950) believes *L. pusillum* to be indistinguishable from *L. ericetorum* Pers. with spores either smooth or verrucose.

There is no material of typical *L. pusillum* from the West Indies at Kew but Glaziou 9184 from Rio de Janeiro, Brasil, seems to have been correctly so referred by Cooke and Duss listed it from Guadeloupe.

2. **Lycoperdon depressum** *Bon.* in Bot. Zeit. 15 p. 611, (1857).

Peridia gregarious or caespitose, 2.5 cm. diam. subglobose to pyriform with a small sterile base and slightly papillate mouth, pure white, becom-

ing warm buff. Exoperidium formed of closely crowded small spines, the larger cohering at the tips in small stellate groups, especially on the upper surface of the peridium, interspersed with smaller spines. Gleba isabella colour, drying light brownish olive, very powdery, sterile base of small white chambers limited above by a distinct diaphragm. Spores globose, yellowish, 3μ diameter, very minutely echinulate ; capillitium hyaline, very thin-walled and easily collapsing, about 5μ diameter. Fig. 14.

Collections seen : Trinidad, on sandy shore above High Water Mark, Cocal, 22.XI.1949, *Dennis* 333.

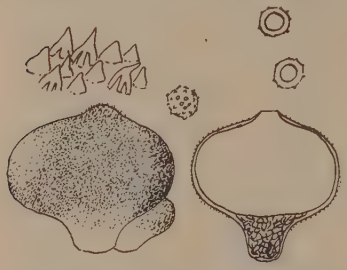

FIG. 14. *Lycoperdon depressum*, peridium and section natural size, exoperidial warts in lens view, spores × 1300, all from Dennis 333.

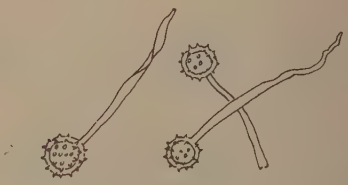

FIG. 15. *Lycoperdon dominicensis*, three spores from the type collection × 1300.

3. **Lycoperdon dominicensis** *Massee* in Grevillea **17,** 60 (1889).

Bovistella dominicensis (Massee) Lloyd in Mycol. Writings **2,** 283 (1906).

Superficially this is very like *L. curtisii*. The type sheet bears two peridia ; that on the left has almost smooth spores without pedicels and a hyaline septate capillitium and may be *L. depressum*, that on the right is evidently the holotype. This is externally similar but contains coarsely warted spores 4μ diameter, with hyaline, slender, persistent pedicels up to 20μ long. Its capillitial threads are about 4μ thick, some hyaline with a vague colourless crumpled envelope, others slightly more thick-walled and yellowish. Fig. 15.

Collection seen : Dominica, Laion Forest, 5.VII.1888, *G. A. Ramage* (Typus).

Because of its peculiar spores this invites comparison with the older *L. pedicellatum* Peck and it is desirable that fresh collections be made in the West Indies for that purpose. Lloyd evidently thought them distinct as he combined both names in *Bovistella*.

4. **Lycoperdon fuligineum** *Berk. et Curt.* in J. Linn. Soc. Bot. **10,** 345 (1868).

Lycoperdon epixylon Berk. et Curt. op. cit.

Lycoperdon confluens Pat. in Bull. Soc. Mycol. France **15,** 203 (1899).

Bovista asterospora Massee in Grevillea **17,** 60 (1889).

Peridia gregarious, mostly 1–2 cm. diameter, subglobose, seated on a white cord-like mycelium. Exoperidium vinaceous-buff but covered except at the base by minute, mealy, dusky-brown spines which tend to cohere at the tips in small clusters ; mouth small, torn. Sterile base very small or almost absent, solid, papilliform; gleba wood-brown at maturity.

Capillitium branched, smooth, hyaline, thinwalled, septate, easily collapsing, 3–4μ diameter. Spores globose, yellowish, echinulate, 3–4μ diameter. On logs and on richly manured soil in gardens. Fig. 15.

Collections seen : Cuba, October, *Wright* 705 (Typus) ; Retiro, July, *Wright* 881 ; *Wright* 249 (Typus of *L. epixylon*) ; Trinidad, Santa Cruz, 14.X.1908, *Broadway* 7037 ; Cedros, on *Cocos*, 22.I.1921, *E. M. Wakefield* ; River Estate, Diego Martin, 24.IX.1949, *Dennis* 41 ; Venezuela, Rancho Grande, Maracay, 19.XI.1949, *Dennis* 41A, all at Kew. Venezuela, " Orinoque, leg. A. Gaillard " ; Guadeloupe, Basse terre, *Duss* 912 (Typus of *L. confluens*) ; Pointe Noire, *Duss* 1089 ; Plateau des Rivières, *Duss* 515, June 1901, all in herb. Farlow. Dominica, *G. A. Ramage* 1888 (Typus of *B. asterospora*).

Fig. 16. *Lycoperdon fuligineum*, peridium and section natural size; above, exoperidial warts in lens view ; below, two spores × 1300, all from Dennis 41.

5. **Lycoperdon atrum** Pat. in Bull. Soc. Myc. France **18,** 176 (1902).

Peridium pyriform, about 2·5–3 cm. high by 2·3–2·4 cm. broad. Exoperidium fuscous over the upper part, clay-coloured below, consisting of very minute warts, scarcely perceptible by the unaided eye, closely crowded on a thin concolorous membrane which has flaked away round the base of the gleba to expose the pinkish buff endoperidium. Sterile base subcylindrical, 7–8 mm. wide with a tapering base or more obconical, cinnamon-buff, minutely and rather obscurely cellular ; the chambers distinguishable towards the base only ; gleba approximately pecan brown, without a diaphragm. Capillitial threads 3–4μ thick, brown, smooth, thick-walled, repeatedly branched, often dichotomously, with long tapering finely pointed ends. Spores globose 4μ diameter, yellowish brown with a narrow hyaline halo, minutely reticulate and so appearing very minutely spinulose in optical section, without persistent pedicels.

Fig. 17. *Lycoperdon atrum*, peridium and section natural size, spore × 1300, on left spines of the exoperidium in lens view, all from the typus in herb. Farlow.

Typus : on the ground, Martinique, P. Duss, in the Farlow herbarium. Fig. 17.

This should perhaps be compared with *L. coloratum* Peck, which is said to be brilliant orange when young.

6. **Lycoperdon pyriforme** *Schaeffer ex Persoon* Syn. Meth. Fung., 148 (1801).

Peridia usually caespitose on rotten wood, more or less pearshaped, often up to 3 cm. diameter, sometimes larger, white when young, at maturity gray-brown to Verona brown. Exoperidium of minute often darker coloured warts, giving a rough feel to the surface. Gleba olive-brown at maturity ; sterile base varying from a small obconical region to a well-developed semicylindrical stem, composed of small compact chambers, seated on a conspicuous, white, cord-like mycelium. Capillitial threads 3–6μ diameter, smooth, thickwalled, dark-brown, sparingly branched. Spores globose, yellowish, smooth, 2·5–4μ, without a pedicel.

West Indian collections seen : Cuba, " Oct. Aug. Dec." *Wright* 707 ; *Wright* 256, 257. Venezuela, Herb. Berkeley, No. 239, unlocalised.

The species is, of course, common throughout the north temperate forests. Wright 900 and 251, also determined by Berkeley as *L. pyriforme*, have distinctly warted spores and are probably to be referred to *L. perlatum* Pers.

7. **Lycoperdon perlatum** *Pers.* Syn. Meth. Fung., 148 (1801).

Peridia solitary or in pairs, terrestrial, pyriform, at first white throughout. Exoperidium of rather small, crowded, conical warts which dry dark brown, each surrounded by a ring of minute granules ; the warts may be shed, leaving the granules as a small-meshed reticulum. Endoperidium papery, drying pale avellaneous above, shading to cream-buff or chamois below. On the sterile base the warts are smaller, denser and more uniform. Gleba Saccardo's umber to bister ; sterile base well developed, with conspicuous thinwalled chambers up to 1 mm. across, cream-buff when dried. Capillitial threads brown, thick-walled, sparingly branched, 4μ thick, smooth except for a vague hyaline more or less granular envelope. Spores globose, yellowish-brown, finely warted, 4μ diameter, without pedicels.

West Indian collections seen : Jamaica, Cinchona, *Dennis* J150, 20. XII.1949. Cuba, *Wright* 251 and 900.

This also is a well known north temperate species but the description is based on the Jamaican material This was from about 5000–6000 ft. in the Blue Mountains, associated with an agaric flora of temperate facies, very different from that of Trinidad. *L. pseudogemmatum* Speg. from Paraguay is, however, very similar, as already noted by Lloyd who thought it only a state of *L. perlatum*, so that the latter may not necessarily be confined to high altitudes in the West Indies.

8. **Lycoperdon ?peckii** *Morgan* in J. Cincinnati Soc. Nat. Hist. **13,** 15 (1891).

Peridium about 2 cm. diameter, somewhat flattened, with a small but well defined sterile base. Exoperidium formed of crowded, slender, brown spines about 0·5–1·0 mm. long, cohering at their tips in small stellate groups of 5 or 6 ; endoperidium vinaceous buff, ornamented by a rather fine-meshed brown reticulum after the spines have fallen. Gleba buffy brown, sterile base whitish, small-celled. Spores globose, very

minutely echinulate under oil immersion lens, yellowish, 3–4μ diameter ; capillitium thick-walled, brown, somewhat irregular 3–5μ thick. Sporophores gregarious in litter on the ground in plantations. Fig. 18.

Collection seen : Trinidad, under *Theobroma*, River Estate, Diego Martin, 27.X.1949, *Dennis* 249. This may be only a small form of *L. perlatum* var. *nigrescens* Pers. as suggested by Lange (1948).

Fig. 18. *Lycoperdon ?peckii*, young and old peridia and section natural size, exoperidial warts in lens view, end of a capillitial thread × 660, spores × 1300.

Diplocystis *Berk. et Curt.* in J. Linn. Soc. Bot. **10,** 344 (1868).

Diplocystis wrightii *Berk. et Curt.* op. cit.

In this very distinctive fungus numerous small peridia about 1 cm. across are packed together on a leathery stroma. The typus at Kew was from Cuba and there are later records from Bahamas (Coker & Couch), Puerto Rico (Overholts) and Guadeloupe.

Disciseda *Czerniaïev* in Bull. Soc. Imp. de Moscou **18,** 153 (1845).

In *Disciseda* there is a two-layered, smooth, globose peridium, without a sterile base, superficially like a *Bovista*, to which genus most of the species have at some time been assigned. The exoperidium cracks in a circle round the base and the whole upper portion falls off, tearing away with it the entire endoperidium and gleba. The latter then dehisces by a small pore at what was originally the base of the endoperidium.

Disciseda candida (*Schw.*) *Lloyd* in Mycol. Writings, **1,** 100 (1902).

Bovista candida Schwein. Synops. Fungi Carolinae Sup., 33 (1822).

Bovista circumscissa Berk. et Curt. in Grevillea **2,** 50 (1873).

Catastoma circumscissum (Berk. et Curt.) Morgan in J. Cincinnati Soc. Nat. Hist. **14,** 143 (1892).

Disciseda circumscissa (Berk. et Curt.) Hollos in Termeszetrajzi Füzetek **25,** 132 (1902).

Peridium globose, 1·5 cm. diameter, exoperidium persisting as a somewhat fibrous cap firmly adhering to part of the endoperidium, the latter smooth, papery, light brown, with a small torn aperture. Gleba powdery, brown ; capillitial threads hyaline, irregular, 3–4μ wide, brittle and breaking into short lengths. Spores globose, light brown, minutely warted, 4μ diameter, with a short, hyaline, persistent pedicel 1–1·5μ

long. On the ground in pastures. The basal part of the exoperidium remains in the ground and is seldom collected. Fig. 19.

West Indian collection : San Domingo, Sallé 67 in herb. Berkeley as *Bovista cervina* Berk. and so published in 1852. The typus of *B. cervina*, from Patagonia, has smooth brown spores, 4–5μ diameter, without a pedicel.

Fig. 19. *Disciseda candida*, Sallé 67 natural size.

Lanopila *Fr.* in K. Vetensk. Akad. Handlinger Stockholm, 151 (1848).

Lanopila wahlbergii *Fr.* op. cit.

This a large, smooth, globose puffball, superficially like a *Bovista*, up to 8 cm. across, without a sterile base. It is separated from *Bovista* by its long, sparingly branched, interwoven, capillitial threads. These are light or dark brown, about 4–6μ wide, slightly constricted at the rather frequent septa and liable to break up into short lengths like those of a *Calvatia*. The spores are brown, 5–6μ diameter, covered with rather coarse warts. Patouillard (1899) reported this species, under the name *L. bicolor* (Lév.) Pat., as common in Guadeloupe. There is no West Indian material so referred at Kew but a Cuban collection filed under an unpublished name in the *Bovista* cover probably belongs here and is cited below.

Collections seen : Guadeloupe, environs de la Basse terre, surtout au Jardin botanique, *Duss* 92 ; St. Kitts, undated, both from Patouillard in herb. Farlow ; Cuba, *Wright* 925.

Fig. 20. *Lycogalopsis solmsii*, peridia natural size, section of young peridium × 6, exoperidial warts in lens view, spores × 1300, from Dennis 86.

Lycogalopsis *E. Fischer* in Ber. Deut. Bot. Gesell. **4,** 192 (1886).

Lycogalopsis solmsii *E. Fischer* op. cit.

Lycoperdon albinum Cooke apud Massee in J. Roy. Microscop. Soc. p. 723, 1887.

Lycogalopsis dussii Pat. in Bull. Soc. myc. France 18 p. 175, 1902.

Mycelium white, cord-like, then forming a more or less widespread white subiculum, within which the peridia develop. Peridia sub-

globose, sessile or nearly so, white, surface finely pulverulent, breaking open irregularly at the apex and ultimately flaking away to expose the gleba. Gleba at first olive-buff, containing numerous narrow elongated chambers radiating from the broad base ; subgleba dark brown, narrow, seated on a thickened stromatic portion of the subiculum ; mature gleba powdery, vinaceous buff, fading to cream-buff. Spores almost hyaline, globose, thin-walled, 2·5–3μ diameter, minutely echinulate ; basidia fusiform, 4–6-spored, 10–12 × 3μ ; capillitium of hyaline thinwalled hyphae, about 2μ wide, which tend to cohere in strands. Fig. 20.

Collections seen : Trinidad, on rotting and charred bamboo, St. Joseph, 27.IX.1949, *Dennis* 86 ; same locality Oct. 1949 ; Arena forest, on branches in litter, 30.X.1949, *Dennis* 86B ; Panama, Ft. Sherman, on palm trunks and roots, 12.VII.1945, *G. W. Martin* 6026 ; Brasil, Barruras de Jutahi, R. Solimoes, *Trail* 45 (Typus of *L. albinum*) ; Martinique, à terre sur le bois pourri, Fonds St. Denis, August 1901, *Duss* 458 (Typus of *L. dussii*, in Herb. Farlow) ; Bermuda, Walsingham, 5.XII.1940, *J. M. Waterston* 386.

Panamanian material of the species has been fully studied by Martin (1939), who showed that great variation existed as regards the degree of immersion of the peridia in the stroma and that *L. dussii* could not be maintained as a distinct species. Peridia of the Trinidad material are almost free at maturity but are completely immersed in the stroma when young.

SCLERODERMATALES

Scleroderma *Pers.* Syn. Meth Fung. 150 (1801).

Scleroderma tenerum Berk. et Curt. in J. Linn. Soc. Bot. **10,** 346 (1868).

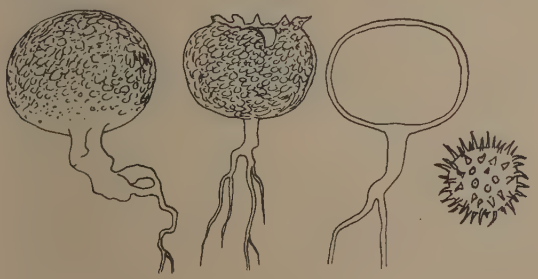

Fig. 21. *Scleroderma tenerum*, peridia and section natural size, spores × 1300, all from Dennis 363.

Peridia subglobose, with a stout rooting base which divides below into numerous strands or small sheets of mycelium, surface pale yellowish buff, closely dotted with minute reddish-brown warts. Gleba pale greyish-brown at maturity, exposed by an irregular rupture of the peridium. Spores spherical, dark brown, 6·8·5μ diameter, covered with more or less pointed hyaline spines so as to measure 7·5–10μ over all.

Collections seen : Venezuela, in swarms on ground in forest, Rio Chacaito, Caracas, 18.XI.1949, *Dennis* 363 ; Cuba, Wright 702 (Typus) ; Jamaica, on forest floor at 5000–to 5500 ft., Cinchona, Blue Mountains, 20.XII.1949, *Dennis* J 143.

Coker & Couch regard this as the tropical form of *S. lycoperdoides* Schw., which differs only in its larger spores, mostly 11–14μ diameter, excluding the spines. Fig. 21.

NIDULARIALES

Sphaerobolus Pers. Syn. Meth. Fung., 115 (1801).

Sphaerobolus stellatus *Tode ex Persoon* op. cit.

The Trinidad material is typical of this cosmopolitan species, with spores elliptical, hyaline, 8–10 × 5–5·5μ, sometimes obovate or slightly reniform.

Collection seen : Trinidad, on bamboo debris, St. Joseph, 18.X.1949, *Dennis* 194.

The West Indian species of *Cyathus* and *Nidula* are being described elsewhere in collaboration with Dr. H. J. Brodie.

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I am indebted to the authorities at the Farlow herbarium for lending to Kew the type collections of several species described from the West Indies by Patouillard and to Mr. D. A. Reid for the spore drawings in figures of *Geastrum*, *Lycoperdon* and *Scleroderma*.

NOTES ON AFRICAN ASCLEPIADACEAE*. III.

A. A. Bullock

These notes continue the process of transferring species hitherto assigned to *Asclepias*, *Schizoglossum* and *Xysmalobium* to other genera where they appear to fit more naturally, and include some observations on other genera.

Pachycarpus E. Mey., resuscitated by N. E. Brown in the *Flora of Tropical Africa* (1902) is increased by the addition of several species placed under *Asclepias* and *Schizoglossum* by Brown and others as well as by two new species, and I have to thank my colleague, Mr. E. Milne-Redhead, for his manuscript notes on the specific differentiation of *P. lineolatus* and *P. schweinfurthii*. This work was carried out some time ago and is extremely critical ; Mr. Milne-Redhead's notes are largely reproduced below.

I wish also to record my indebtedness to Miss P. Halliday who carried out the dissections on which my analysis of the *Stathmostelma pedunculatum*—*S. rhacodes* complex depend, and to Mr. P. Taylor for his drawings of *Trachycalymma*, a new genus based on *Gomphocarpus cristatus* Decne. [*Asclepias palustris* (K. Schum.) Schltr. of the Flora of Tropical Africa].

The detailed examination of large numbers of specimens has again led to the proposal of extensive new synonymy ; this does not imply that differences observed and recorded by earlier workers do not exist, but that the significance of such differences, often allied to wide geographical separation of the specimens available to them, was exaggerated. All the species mentioned below occur in dry savannah or thorn-scrub country or in the seasonal swamp grassland with which such country is interspersed ; they are, therefore, subject to the influence of bush fires and their stature, leaf-texture, indumentum, flower size and colour, and other characters, are often profoundly affected, varying from year to year according to the severity of burning, the amount and date of the early rains, and surrounding cover.

I should like to draw the attention of collectors to the interesting but insignificant *Cynanchum praecox*, now recorded from several widely separated localities (see p. 354) ; the rootstock, fruit and mature leaves are still unknown.

Pachycarpus *E. Mey.*

Most of the following species were placed in *Asclepias* by N. E. Brown in his treatment of the *Asclepiadaceae* in the *Flora of Tropical Africa* and the *Flora Capensis* ; I have extracted some of them from *Schizoglossum*, two are new and one is newly recorded for tropical Africa.

The *Flora Capensis* included several species and the genus is widely distributed through the area of that flora, but the *Flora of Tropical Africa* included only two species assigned to *Pachycarpus* and only one of these was recorded from as far north as Tanganyika. The treatment proposed here extends the range of the genus to the whole of tropical Africa south of the Sahara and the distribution of the species follows a plan similar to that formerly observed for the South African species.

*Continued from Kew Bull. **1953,** 67 (1953).

For the delimitation of the genus I have relied more particularly on the general facies of the species, the texture, indumentum, shape and venation of the leaves, the rootstock and fruit, than upon the exact form of the corona. The latter organ provides very useful specific characters and its general structure is of generic significance, but its value was much overstressed by Brown, who regarded it as a governing factor.

E. P. Phillips (Gen. S. Afr. Fl. Pl. ed. 2, 502 (1951)) cited *P. grandiflorus* Linn. f. E. Mey. as the neotype of the generic name and this I have accepted. The genus was described by E. Meyer (Comm. Pl. Afr. Austr. 209 : 1837) and was maintained by some authors (e.g. Planch. 1856, 1868; Endlicher, 1838; N. E. Brown, 1902, 1903) but rejected by Bentham (in Benth. et Hook. f. Gen. Pl. **2**, 754 (1876)) who merely mentions it in his notes under *Gomphocarpus* R. Br., and by K. Schumann (in Engl. et Prantl, Natürl. Pflanzenfam. **4** (2), 337 (1895)) who cited it as a synonym of *Gomphocarpus*. Duemmer referred *Pachycarpus* to *Dregea* E. Mey. with which it certainly has much in common, while Schlechter placed it under *Asclepias*.

Pachycarpus schweinfurthii (N. E. Br.) Goyder, comb. nov.

Asclepias schweinfurthii N. E. Br. in Kew Bull. **1895**, 253 (1895), et in Thiselton-Dyer, Fl. Trop. Afr. **4** (2), 829 (1902); Andreves, Fl. Pl. Anglo-Egypt. Sudan, **2**, 401 (1952).

A. conspicua N. E. Br. *l.c.* 253, et *l.c.* 324.

Caloreopa buchanani K. Schum. in Engl. Bot. Jahrb. **33**, 229 (1903); N. E. Br. *l.c.* 615 (1904).

The reduction of *Asclepias conspicua* and *Caloreopa buchanani* was carried out by Mr. Milne-Redhead (MS. in herb. Kew) as a result of careful comparison of the type and only available specimen of the former and of a specimen which had been compared with German material at the East African Herbarium, Amani, of the latter with the abundant material of *Pachycarpus schweinfurthii* now preserved at Kew but formerly often named *Asclepias uncinata*. *Pachycarpus linearis* Decne. My own examination of the material, carried out quite independently and from a somewhat different viewpoint, endorses Mr. Milne-Redhead's conclusions.

In his original diagnoses of *Asclepias schweinfurthii* based on *Schweinfurth* 1951 from Jur, southern Sudan, and *A. conspicua* based on *Carson* s.n. from Fwambo, Northern Rhodesia, Brown (1895) did not differentiate either species from *Asclepias uncinata*, which was already known to have a wide savannah distribution in tropical Africa and was described from a specimen in the Paris herbarium from Angola. In the *Flora of Tropical Africa*, Brown (1902) distinguished them as follows :—

"Coronal-lobes distinctly shorter than the staminal column . . . . . *A. linearis*

Coronal-lobes reaching to the level of the top of the staminal column or beyond . . . . . *A. schweinfurthii*"

As Mr. Milne-Redhead remarks "this character is unfortunately a difficult one to use in pressed specimens but it shows up fairly well if a flower be softened by boiling. When flowers preserved in spirit the character becomes abundantly clear and additional characters of the

actual shape of the corona lobes may also be used". I append Mr. Milne-Redhead's (Sept. 1951) critical notes for distinguishing the two species, substituting the appropriate names under *Parlyaria* for his *Asclepias* :—

"In *Parlyaria schweinfurthii* the corona-lobe is widest towards the base, and narrows gradually upwards adaxially to a keel or ridge formed by the closely adpressed upper edges and abaxially to a tongue, variable in length, which projects upwards or outwards and which is flattened dorsally. The adaxial corner of the keel is level with the flat top of the staminal-column and projects slightly so as to touch the edge of the column. The corona-lobe is quite hollow. The suture of the horny anther wings is parallel to the axis of the staminal-column.

"In *P. linearis* the corona-lobe is widest towards the top, and narrows gradually below. The upper margin adaxially is curved forming an outer rim to the somewhat saucer-shaped upper surface, whilst the free edges meet along a median slightly raised line. Abaxially the corona-lobe is produced into an ascending rather blunt spur which sometimes has a tendency to be incurved. The adaxial upper corner of the corona-lobe is level with a point about half way up the staminal-column and does not touch the column. The corona-lobe is not or scarcely hollow. The suture of the horny anther-wings diverges outwards and downwards from the axis of the staminal-column.

" The leaves of these two species are very similar and in each they vary considerably in shape. I have not been able to find a satisfactory character for determining the species from the foliage alone.

" The follicle of *P. linearis* is blunt and inflated. Three gatherings of *P. schweinfurthii* show that species to have a fusiform follicle, narrowed to a point above and into a definite stipe below. Other flowering specimens of *P. schweinfurthii* have, mounted on the same sheet, an inflated fruit similar to that of *P. linearis*. It is possible that these inflated fruits do not belong to *P. schweinfurthii*, but have been taken by the collector from a nearby fruiting specimen of *P. linearis*. The specimens with this inflated fruit are *Snowden* 132 from Toro, Uganda, *Dunn* 491 also from Toro, and *Wallace* 266 from Mongono in Tanganyika. I am familiar with both these species in the Mwinilunga District of Northern Rhodesia, where *P. linearis* flowers at the beginning of November and *P. schweinfurthii* at the end of December or early in January, roughly six weeks later, by which time the fruits of *P. linearis* are well developed. It would normally not be possible at this locality to collect simultaneously the flowers and fruits of *P. schweinfurthii* for the latter were scarcely fully developed by the middle of February when I left the District. It must be mentioned that these two species occupied distinct but adjacent habitats, and in some cases it was only necessary to move a few yards to go from *P. linearis* in the *Cissus, Lannea, Sphenostylis* grasslands to *P. schweinfurthii* in the *Brachystegia* woodlands. The habit and leaves of these two species are so very alike that for collectors occasionally to associate the fruit of one with the flowers of the other is only to be expected. That *P. schweinfurthii* has not often been collected in fruit is a fact that can be accounted for partly because it fruits when no similar plant is in flower

and partly because the fusiform follicles are relatively inconspicuous when growing among grass, compared with the large inflated follicles of *P. lineolatus*."

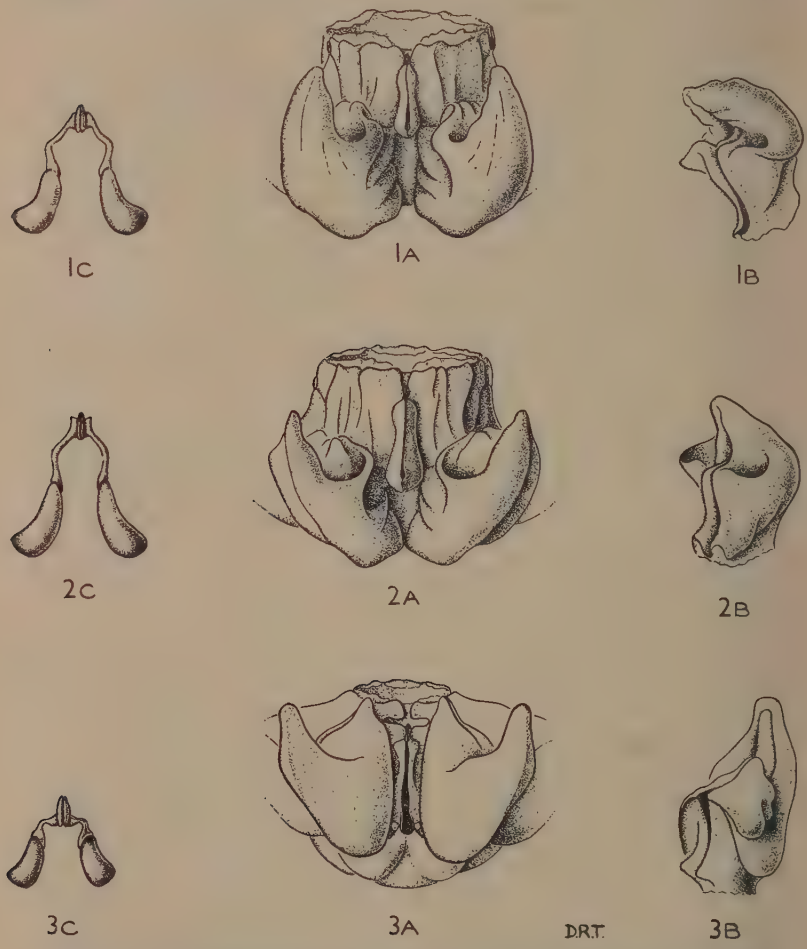


FIG. 1. *Pachycarpus lineolatus* (Decne.) Bullock, drawn from *Keay* 25897 (1) and *Milne-Redhead* 3072 (2), and *P. schweinfurthii* (N. E. Br.) Bullock, drawn from *Milne-Redhead* 3836 and 3235a (3).
A. Gynostegium, × 4 ; B. Corona-lobe, × 4 ; C. Pollinium, × 8.

Mr. Milne-Redhead goes on to express doubt as to his conclusion concerning mixed gatherings, but I have made similar observations in southern Tanganyika and Northern Rhodesia and consider that he is perfectly correct.

P. schweinfurthii is now represented at Kew by some fifty gatherings from Nigeria, British and French Cameroons, Belgian Congo, Southern Sudan, Uganda, Kenya, Tanganyika, Northern Rhodesia and Angola. This distribution is compared with that of *P. lineolatus* in the table on p. 333.

Pachycarpus lineolatus (*Decne.*) *Bullock*, comb. nov.

Gomphocarpus lineolatus Decne. in Ann. Sc. Nat. Sér. 2, **9,** 326 (1838), et in DC. Prodr. **8,** 558 (1844) ; K. Schum. in Engl. Bot. Jahrb. **17,** 126 (1893), et in Engl. Pflanzenw. Ost Afr. **C,** 322 (1895) ; Durand et Schinz, Études Fl. Congo, **1,** 193 (1896)* ; De Wild. et Durand in Ann. Mus. Congo, Sér. 2, Bot. **1** (2), 41 (1900)*; De Wild. in Ann. Mus. Congo, Sér. 5, **1,** 184 (1904),* et *l.c.* 304 (1906)*.

G. bisacculatus Oliv. in Trans. Linn. Soc. Ser. 2, Bot. **2,** 341 (1887).

Asclepias lineolata (Decne.) Schltr. in Journ. Bot. **33,** 336 (1895), partim, et Westafr. Kautschuk-Exped. 308 (1900) ; Hiern in Cat. Afr. Pl. Welw. **1,** 685 (1898) ; Henriques in Bol. Soc. Brot. **16,** 68 (1900) ; S. Moore in Journ. Bot. **40,** 256 (1902) ; N. E. Br. in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 322 (1902) ; Hutch. et J. M. Dalz. Fl. W. Trop. Afr. **2,** 56, f. 196 (1931) ; Andrews, Fl. Pl. Anglo-Egypt. Sudan, **2,** 400 (1952).

A. browniana S. Moore in Journ. Bot. **47,** 217 (1909).

[*Gomphocarpus robustus* (non A. Rich.) ;—Oliv. in Trans. Linn. Soc. **29,** 110 (1875)].

[*Asclepias robustus* (non (A. Rich.) N. E. Br.) ;—N. E. Br. in Thiselton Dyer, Fl. Trop. Afr. **4** (1), 324 (1902), quoad spec. Speke et Grant No. 555 cit.].

The close alliance of this species with *P. schweinfurthii* has often resulted in confusion of the two. Mr. Milne-Redhead's analysis, quoted above under *P. schweinfurthii*, should correct this. It will be recalled that in my discussions of *Gomphocarpus fruticosus* (Linn.) Ait. f. and its allies (Kew Bull. **1952,** 406 et seqq.), I postulated the existence of hybrid swarms. In view of the extensive and overlapping distributions of *P. schweinfurthii* and *P. lineolatus*, shown in tabular form below, similar hybrids might have been expected in this case. That they do not occur may, however, be regarded as certain, since their flowering times differ by about six weeks and they are also ecologically isolated. On these points Mr. Milne-Redhead's field observations in northwestern Northern Rhodesia are confirmed by my own in eastern Northern Rhodesia and southwestern Tanganyika.

	French Guinea	Gold Coast	Nigeria	Cameroons	Sudan	Uganda	Kenya Colony	Tanganyika	Belgian Congo	Angola	Northern Rhodesia	Southern Rhodesia	Nyasaland	Moçambique
P. lineolatus	+	+	+	+	+	+	+	+	+	+	+	+	+	+
P. schweinfurthii ...			+	+	+	+	+	+	+	+	+			

*I have not seen the specimens on which these records are based.—A.A.B.

Pachycarpus robustus (*A. Rich.*) *Bullock*, comb. nov.

Gomphocarpus robustus A. Rich. Tent. Fl. Abyss. **2,** 40, t. 70 (1851) ; K. Schum. in Engl. Pflanzenw. Ost Afr. **C,** 322 (1895).

G. drepanostephanus Hochst. in Herb. Schimp. Abyss. No. 1673, nomen.

Asclepias robusta (A. Rich.) N. E. Br. in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 324 (1902), excl. spec. Speke et Grant No. 555 cit.

The Uganda specimen (*Speke and Grant* 555) referred by Oliver (1875 : see under *P. lineolatus*, p. 333) to this species and retained in it by N. E. Brown (1902) is more naturally placed under *P. lineolatus*. The specimen at Kew consists of a broken leafy stem and a single detached follicle. The fruits of *P. robustus* are unknown and the only material at Kew is a specimen of the type collection (*Quartin Dillon*) and two sheets of *Schimper* 1673 ; both were collected in Abyssinia. The plant is similar in habit to both *P. lineolatus* and *P. schweinfurthii*, but it is at once distinguished by its long-beaked coronal lobes ; the leaves are cuneate or at most rounded at the base, never cordate or truncate.

Pachycarpus fulvus (*N. E. Br.*) *Bullock*, comb. nov.

Asclepias fulva N. E. Br. in Kew Bull. **1895,** 254 (Oct. 1895), et in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 321 (1902).

A. rubicunda Schltr. in Journ. Bot. **33,** 336 (Nov. 1895).

This species is at once distinguished by the reddish tomentum on the younger parts and by its deep orange or chestnut-brown flowers. Mrs. Brodhurst-Hill, who collected it in the Kipkarren district of Kenya, remarked on its rubbery latex which is used by the natives for the repair of broken gourd utensils ; the vernacular name is Lobundwabundwe.

The corona-lobes are complicated structures in which the dorsal horn or tongue so characteristic of some other species is suppressed. The upper edges are very closely adpressed together and turned outwards to form a flat thickened rim, whilst the adaxial edges are scarcely separable. At the base there is a flat thickened portion at right-angles to the staminal column which is produced into a short up-curving spur abaxially, recalling the corona-structure of *Kanahia laniflora* (Forssk.) R. Br.

It was described almost simultaneously by N. E. Brown and by Schlechter, both authors using specimens collected in Uganda. (*Wilson* 112, holotype ; *Scott-Elliott* 7443, 8088). There is at Kew one further collection from Uganda, from the short grasslands of Kigezi (*Purseglove* 2042). In addition to Mrs. Brodhurst-Hill's plant mentioned above, the species has been collected in Kenya by *Mrs. Tweedie* (No. 565) on the southern slopes of Mt. Elgon at 6500 ft. Such a compact distribution is a fairly normal one, but there is a further specimen at Kew, collected by *Eyles* (No. 4429) at Salisbury, S. Rhodesia, which must be placed within the species. This indicates a real distribution comparable with that of *P. schweinfurthii* and *P. lineolatus*.

Pachycarpus mildbraedii *Bullock*, sp. nov. a *P. lineolato* (Decne.) Bullock foliis angustioribus plus minusve lanceolatis apice basique acutis vel apice basique versus gradatim angustatis haud apice rotundatis et basi rotundatis vel cordatis ; a *P. robusto* (A. Rich.) Bullock foliis similiter

diversis, coronae lobis abaxialiter in linguam patenti-adscendentem truncatam haud acutam productis ; a *P. lineolato*, *P. robusto*, et *P. schweinfurthii* (N. E. Br.) Bullock habitu tenuiore, floribus plane minoribus, folliculis erectis anguste fusiformibus satis longe stipitatis haud inflatis nec alatis facile distinguitur.

Cameroons. Buar, 6° N. 15° 35′ E., about 1000 m., May 1914 (fl., fr.), *Mildbraed* 9391 (*holotypus in herb. Kew.*) ; 50 km. south-east of Buar, about 800 m., June 1914 (fr.), *Mildbraed* 9622.

This species was distributed from Berlin under the manuscript name *Asclepias mildbraedii* Schlechter. It is distinguishable from *P. lineolatus*, *P. schweinfurthii* and *P. robustus* by its more slender habit and narrow lanceolate leaves, and by its coronal lobes which differ widely from those of *P. lineolatus* and *P. schweinfurthii* but approach those of *P. robustus*. All parts are, however, smaller than in that species and the apex of the tongue-like abaxial projection is truncate ; when dry it tends to become complicate and then appears to be bifid. The follicles, which become erect with a ' kinked ' pedicel, are narrowly fusiform, up to 15 cm. long and narrowed towards the base into a distinct stipe. In this character it approaches *P. schweinfurthii* and differs markedly from *P. lineolatus*, which has inflated, blunt, exstipitate follicles. The fruit of *P. robustus* is unknown.

Pachycarpus medusonema *Bullock* sp. nov. inter species congeneres gynostegio elongato, corona velut longe stipato, coronae lobis complicatis e basi antherarum ortis apice adaxialiter utrinque rostro erecto anguste conico carnoso et abaxialiter in appendicem lineari-filiformem radiato-patentem elongatam productis distinctissima.

Herba perennis, caulibus simplicibus mediocribus pubescentibus e radice lignoso ortis. *Folia* petiolata, anguste oblonga, apice basique acuta, circiter 9 cm. longa et 2 cm. lata, superiora sensim minora, inferiores gradatim minora et basin caulis versus cataphyllaria, utrinque crispato-pubescentia, petiolis usque 5 mm. longis sed saepe brevioribus. *Flores* terminales, unbellatim dispositi, bracteis filiformibus pubescentibus 5–8 mm. longis, pedicellis pubescentibus tenuibus 2 cm. longis. *Calyx* extra pubescens, fere ad basin divisus ; lobi triangulari-subulati, 6 mm. longi, basi 1 mm. lati. *Corollae lobi* glabri, patentes, lanceolati, acuti, 1·5 cm. longi, 4·5 mm. lati. *Coronae lobi* e basi antherarum orti, rectangulares, erecti, antheris sesquilongiores, 4 mm. longi, complicati, adaxialiter rostro conico carnoso erecto 3 mm. longo utrinque ornati, abaxialiter appendice patente lineari-filiforme 1·5 cm. longo praediti. *Antherae* vix 3 mm. longae, appendicibus membranaceis late ovatis supra stigma inflexis. *Folliculi* ignoti.

French Cameroons. Ngaundere, about 1200 m., Aug. 1914 (fl.), *Midlbraed* 10127 (*holotypus in herb. Kew.*).

The remarkable corona of this species which appears to arise from a stipe high above the centre of the corolla, makes it so distinct that I have no hesitation in describing it from a single specimen. In stature and general facies the plant is similar to *P. mildbraedii*, described above.

Pachycarpus distinctus (*N. E. Br.*) *Bullock*, comb. nov.

Margaretta distincta N. E. Br. in Kew Bull. **1895,** 255 (1895) ; Bullock in Kew Bull. **1953,** 57 (1953).

Schizoglossum scyphostigma K. Schum. in Engl. Bot. Jahrb. **30,** 384 (1901) ; N. E. Br. in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 372 (1902).

S. distinctum (N. E. Br.) N. E. Br. *l.c.* 371.

S. chirindense S. Moore in Journ. Bot. **46,** 295 (1908).

In my earlier note on this species I pointed out that it showed a variation in the corona structure similar to that observed in *Margaretta rosea*. I now find that such a variation is widespread and occurs in several species of *Pachycarpus* and other genera. This species is in fact very near to *P. rhinophyllus*. I now exclude the specimens collected by *Stolz* (*No.* 2356) and *Davies* (No. E. 26).

I can offer no adequate reason for having transferred this plant back to *Margaretta*, except my desire to take it out of *Schizoglossum*. It cannot be regarded as even a connecting species between *Margaretta* and *Pachycarpus*.

Schizoglossum gigantiglossum Weim. in Botan. Notis. **1935** (No. 22), 393, ff. 16, 17a-e (1935), probably belongs here, but I have not seen the type material.

Pachycarpus grantii (*Oliv.*) *Bullock*, comb. nov.

Schizoglossum grantii Oliv. in Trans. Linn. Soc. **29,** 109, t. 74 (1875) ; K. Schum. in Engl. Bot. Jahrb. **17,** 124 (1893), et in Engl. Pflanzenw. Ost Afr. **C,** 321 (1895) ; N. E. Br. in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 370 (1902).

Gomphocarpus grantii (Oliv.) Schltr. in Journ. Bot. **33,** 269 (1895).

Asclepias grantii (Oliv.) Schltr. *l.c.* 369.

The leaves of species of *Pachycarpus* are unreliable as guides to specific differentiation largely because their shapes are variable within wide ranges and all of them have similar venation ; the lower ones are usually reduced to cataphylls and the upper ones, in the floriferous region, tend to be elongated and narrower than the middle ones. In this species the leaves are very uniform in the middle region ; they are very shortly petioled, truncate or cordate with a broad shallow sinus, oblong or oblong-ovate in shape and rounded or broadly acute at the apex.

The follicles, borne on ' kinked ' pedicels are 3·5–4 cms. long and are provided with three or four longitudinal wings one or more of which may be free in its upper part and appear as a large broadly triangular upwardly directed tooth. So far as fruits are known in the genus, it is unique.

The species is known from Tanganyika and Kenya and the following specimens are preserved at Kew :—

Tanganyika Territory. Karagwe, Dec. 1861 (fl.), *Speke and Grant* 216 (holotype). Katish to Nangwa, Mt. Hanang, 6500 ft., Feb. 1946 (fl., fr.), *Greenway* 7570. Hills east of Kolo, Kondoa District, 5000 ft., Jan. 1928 (fl.), *Burtt* 1197, 1757. Bereku ridge, near Ufiume, Kondoa District, 5000 ft., Jan. 1928 (fl.), *Burtt* 1136. Eastern slopes, Ufiume Mt., 5500 ft., Jan. 1930 (fl. fr.), *Burtt* 2719. Buhamira, Bukoba District, 4000 ft., Oct. 1931 (fl.), *Haarer* 2324.

Kenya Colony. Londiani, 7400 ft., April 1932 (fl.), *Graham* 2808. Marmanet, 25 miles north of Thomson's Falls, 7000 ft., April 1951 (fl.), *Davis* 46. Kapenguria, West Suk, 7000 ft., May 1932 (fl., young fr.), *Napier* 1944. Lugalambo, June 1921 (fl.), *Lankester* s.n. Sotik, 6000 ft., June 1950 (fl.), *Bally* 8741. Elgeyo forest edge, in grassland, April 1943 (fl.), *Bally* 2515. God's Hill, 7 mls. west of Thomson's Falls, 7800 ft., July 1950 (fl.), *Lacey* 19. Nanyuki, Meru, 8000 ft., Jan. 1932 (fl., young fr.), *van Someren*

1716. (This specimen appears to have been taken from a depauperate, semiprostrate plant ; the young fruit is exceptional in being densely hirsute and its wings are very narrow). Mr. P. J. Greenway provides the following notes, giving the vernacular (Kimbulu) name as Khambalau :—" Roots soaked in water or crushed and given to young stock as a purgative. A perennial white and pale purple herb with winged follicles. Locally dominant with *Thunbergia* and *Scabiosa* in *Themeda triandra—Exotheca abyssinica—Eragrostis* grassland and open *Dombeya—Acacia stenocarpa—Carissa edulis* bushland on a reddish-brown loam of volcanic origin ".

Pachycarpus eximius (*Schltr.*) *Bullock*, comb. nov.

Asclepias eximia Schltr. in Journ. Bot. **33,** 335 (1895).

Schizoglossum eximium (Schltr.) N. E. Br. in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 370 (1902) ; Bullock in Kew Bull. **1933,** 79 (1933) ; Robyns, Fl. Sperm. Parc Nat. Albert, **2,** 89 (1947) ; Andrews, Fl. Pl. Anglo-Egypt. Sudan, **2,** 416 (1952).

I am unable to separate this species satisfactorily from *P. grantii* except by the greater size of all parts. It is a very robust plant, but its flower structure is very like that of *P. grantii*. N. E. Brown (1902), having only the holotype of one and a syntype of the other at his disposal, made use of a fancied difference in the shape and structure of the coronal lobes in his key, whilst in his descriptions he states that the coronal lobes arise from the base of the staminal column in *P. grantii* and at its apex in *P. eximius*. My own dissections do not confirm this statement.

Mr. H. C. Dawkins' suggestion (see below) that this plant is sterile is of interest in view of its evident affinity with *P. grantii* and one is tempted to postulate some kind of chromosome disturbance. It will be noted that it has been collected in flower between January and October, but there is only one collection of fruits at Kew. In this the follicles, similar to but larger than in *P. grantii*, contain small, possibly non-viable, seed. If it is a sterile derivative of *P. grantii*, however, it is difficult to see how it has attained its very extensive distribution.

I have not seen specimens from the Belgian Congo, but the species is recorded from the Albert National Park by Robyns (1947). The following material is at Kew :—

Sudan. Yei River, Lado (Rejaf road), Nov. 1919 (fr.), *Sillitoe* 450 ; (Barabas), Nov. 1919 (fl.), *Sillitoe* 453. Nile–Congo divide between Yei and Meridi, Khor Tora, April 1937 (fl.), *Myers* 6451. Itibol, Imatong Mts., 6500 ft., Dec. 1935 (fl.), *Thomas* 1650.

Uganda. Ankole, 5000 ft., *Dawe* 418. Bunyariguru, Ankole, 4200 ft., Sept. 1938 (fl.), *Purseglove* 413. Masaka, Oct. 1925 (fl.), *Maitland* 879. Masaka, Buddu, 5000 ft., *Dawe* 3. Villa Maria, Masaka, 4000 ft., April 1935 (fl.), *Thomas* 1266. Mubendi, 4500 ft., April 1931 (fl.), *Hargreaves* ex *Snowden* 2043. Napak, Karamoja, 6000 ft., May 1940 (fl.), *Thomas* 3590. Kibale, Toro, 5000 ft., *Snowden* 131. Mabira forest, Chagwe, July 1917 (fl.), *Ussher* 33. Serere, 3600 ft., May 1932 (fl.), *Chandler* 531. About seven miles south of Mutyana, near summit of Nkokonjeru hill, Busuja, Buganda, 4000 ft., Jan. 1950 (fl.), *Dawkins* 500. Without exact locality, *Fyffe* 116. Virungo, Toro, 5300 ft., April 1894 (fl.), *Scott Elliot* 7627 (syntype).

Kenya Colony. Mt. Elgon, 7000 ft., May 1932 (fl.), *Chater-Jack* 250, 265 : 6600 ft., March 1931 (fl.), *Lugard* 570: June 1934 (fl.), *Tweedie* 163. Kama Koga, 5000 ft., April 1936 (fl.), *Mainwaring* 30. Sibu, Nandi country, *James* s.n.

Tanganyika Territory. Bukoba District : Nsunga, 4100 ft., Oct. 1931 (fl.), *Haarer* 2306 : Nshamba, Sept.–Oct. 1935 (fl.), *Gillman* 545.

So far as they go, collectors' notes are in agreement in regard to habit, flower colour and habitat. The following notes are taken from Mr. H. C. Dawkins' gathering :—" Heavily trampled bare soil, grey sandy loam over quartzite exposed as gravel and boulders. Severely grazed grassland with many bare patches, a few *Acacia seyal* var. *multijuga* and *Combretum gueinzii*, the only trees, with some stunted *Dissotis macrocarpa*, *Acalypha villicaulis*, *Lippia grandifolia* and this species forming most of the herb community.

Probably annually burnt, but not severely. Common in this restricted locality, apparently favoured by relative absence of grass and immunity from grazing and browsing. A stiffly erect herb, perennial, 30—60 cms. high, one to five stems from the base, not branching above ground. Leaves regularly decussate. Inflorescences semi-pendulous, completely so after the flowers become mature. Pedicels dark red, usually green on one side. Sepals green with maroon midrib broadened at the base, and even the lamina minutely maroon-speckled. Petals pure white. Outer (*sic*) corona lobes deep maroon distally, grading to cream at the base. Inner corona [*gynostegium*] dark green at concave apex of funnel-shaped pit, yellow-green at margin. All parts with white latex. Apparently no fruits formed ; numerous withering flowers examined evidently not fertilized."

Pachycarpus spurius (*N. E. Br.*) *Bullock*, comb. nov.

Xysmalobium spurium N. E. Br. in Kew Bull. **1895,** 251 (1895).

X. dolichoglossum K. Schum. in Engl. Bot. Jahrb. **28,** 456 (1900).

Schizoglossum spurium (N. E. Br.) N. E. Br. in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 367 (1902).

S. dolichoglossum (K. Schum.) N. E. Br. *l.c.*

N. E. Brown (1902) separated the two species included here by means of a somewhat obscure difference in the apex of the coronal lobes, a character which is shown by the more adequate material now available to be of no value. There is a considerable variation in flower size.

The coronal lobes consist of dorsiventrally flattened conspicuous tongues curving upwards from the base of the staminal column. The complicate basal portion so evident in *P. robustus*, *P. lineolatus* and their allies is here reduced to two fleshy contiguous folds. The fruit is still unknown though there are now at Kew two collections from Nyasaland (the *locus classicus*) and four from Tanganyika.

Pachycarpus schinzianus (Schltr.) N. E. Br. in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 376 (1902), in obs., et in Thiselton-Dyer, Fl. Cap. **4** (1), 727 (1908).

Gomphocarpus schinzianus Schltr. in Engl. Bot. Jahrb. **20,** Beibl. No. 51, 37 (1895).

Asclepias schinziana (Schltr.) Schltr. in Journ. Bot. **34,** 455 (1896) ; Rand in Journ. Bot. **41,** 200 (1903).

There is a record of this species for the Orange Free State, but its centre of distribution is in the Transvaal ; there is a large number of gatherings at Kew. The species shows considerable variation in flower size and in leaf shape and size. The most conspicuously variable feature in the flowers is in the size—both length and width, of the tongue of the coronal lobes ; the leaves are from broadly to narrowly triangular or triangular-ovate in shape but are always truncate or somewhat cordate at the base. The following is the first record for tropical Africa :—

Southern Rhodesia. Charter, 4000 ft., " an erect herb, flowers lake-red, lower part of petals paler, lobes of corona pale yellow," Dec. 1926 (fl., young fr.), *Eyles* 4588.

Pachycarpus goetzei (*K. Schum.*) *Bullock*, comb. nov.

Schizoglossum goetzei K. Schum. in Engl. Bot. Jahrb. **28,** 455 (1900) ; N. E. Br. in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 371 (1902).

S. simulans N. E. Br. *l.c.* 369.

The holotype and other material of *S. goetzei* described by K. Schumann was not seen by N. E. Brown (1902), and is now, presumably, lost. I can

find nothing in the description to separate *S. simulans* from it. There is at Kew a specimen collected by *St. Clair-Thompson* in February, 1932 (No. 542) at the Mchombo river on the Iringa-Mbeya road, which must be very near the *locus classicus* and which is undoubtedly conspecific with *S. simulans*, collected by *Whyte* (Nos. 108, 129) in July, 1896, on the Nyika Plateau of Nyasaland. I have not seen any other material.

Pachycarpus rhinophyllus (*K. Schum.*) *N. E. Br.* in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 377 (1902).

Gomphocarpus scaber K. Schum. in Engl. Bot. Jahrb. **17,** 124 (1893), non Harv. (1863)*.

G. rhinophyllus K. Schum. in Engl. Pflanzenw. Ost Afr. **C,** 322 (1895).

G. trachyphyllus K. Schum. in Engl. et Prantl, Naturl. Pflanzenfam. **4** (2), 237 (1895).

N. E. Brown's selection of *rhinophyllus* as the correct epithet for this species depends on the fact that the *Pflanzenwelt* appeared before October 1895, when the *Pflanzenfamilien* was published. Both *G. rhinophyllus* and *G. trachyphyllus* were new names for *G. scaber* K. Schum., a later homonym.

The holotype, of which a leaf and flower are preserved at Kew, was collected by *Fischer* (No. 399) on the eastern shore of Lake Victoria ; it is now known also from several localities in Kenya and there are at Kew two collections from the Mbulu district of Tanganyika. Mr. P. J. Greenway, who found it near Shesheda at 7000 ft. on the north-eastern slopes of Mt. Hanang in February, 1946 (No. 7630), provided the following notes :—

" A perennial solitary-stemmed herb with solitary umbels of white flowers. Not very common but scattered with *Asclepias* [*Pachycarpus*] *schweinfurthii*, *Scabiosa columbaria*, *Crepis* sp., *Gerbera piloselloides* in *Themeda triandra–Exotheca abyssinica–Sporobolus–Setaria–Digitaria scalarum* grassland subject to grazing. Pod large, inflated, six-winged towards the tip, leaves undulate-margined."

Mr. Greenway did not send follicles, but there are other specimens with fruit at Kew, showing the wings. The latter are quite narrow and occupy no more than a third of the total length (about 10 cms.). Although to some extent inflated, the follicles are not inflated in the same way as those of *P. lineolatus*, being narrowed to a point at the apex and to a short stipe at the base, very much as in *P. schweinfurthii*.

Gomphocarpus *R. Br.*

I have already (Kew Bull. **1952,** 406–410) transferred to this genus some of the species which were referred to *Asclepias* by N. E. Brown and others. The following notes continue this process and complete it so far as the species included in the *Flora of Tropical Africa* are concerned. Those of the *Flora Capensis* and others described since the date of the two floras will be accounted for later.

Gomphocarpus longissimus *K. Schum.* in Engl. Bot. Jahrb. **30,** 382, (1901).

Gomphocarpus scaber* Harv. Thes. Cap. **2, 58, t. 192 (1863), is *Pachycarpus scaber* (Harv.) N. E. Br. in Thiselton-Dyer, Fl. Cap. **4** (1), 719 (1908).—A. A. B.

Asclepias longissima (K. Schum.) N. E. Br. in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 338 (1902).

N. E. Brown (1902) recorded two collections of this species, both from southern Tanganyika, and there is a third in the Kew herbarium from the Kyimbila District, collected by *Stolz* (No. 2579) in March, 1914.

Gomphocarpus tanganyikensis (*Bruce*) *Bullock*, comb. nov.

Asclepias tanganyikensis Bruce in Kew Bull. **1934,** 303 (1934).

Gomphocarpus solstitialis (*A. Chev.*) *Bullock*, comb. nov.

Asclepias solstitialis A. Chev. in Mém. Soc. Bot. France, No. 8, 270 (1917), et Expl. Bot. Afr. Occ. Franç. 434 (1920) ; Hutch. et J. M. Dalz. Fl. W. Trop. Afr. **2,** 56 (1931), et in Kew Bull. **1937,** 339 (1937), descr. lat. nov.

Hutchinson and Dalziel overlooked Chevalier's description and they (1937) cited a different type (*Chevalier* 22017) in place of *Chevalier* 21849 which he had designated. The error is of no particular significance since the plants are conspecific but it places the holotype in the Paris herbarium, not at Kew.

Chevalier (1917) placed this species near to *A. lisianthoides* (Decne.) N. E. Br. which I (Kew Bull. **1952,** 416 : 1952) have transferred to *Glossostelma*. It is in fact a near ally of *G. longissimus* K. Schum.

Gomphocarpus kamerunensis (*Schltr.*) *Bullock*, comb. nov.

Asclepias kamerunensis Schltr. in Engl. Bot. Jahrb. **51,** 137 (1913), et in Mildbr. Wiss. Ergebn. Deutsch Zentr.-Afr. Exped. 1910–11, **2,** 68 (1922).

The two specimens of this species cited by Schlechter (1913), *Ledermann* 5663 (the holotype) and *Mildbraed* 4860, must have been lost in the destruction of the Berlin herbarium. There is at Kew, however, a specimen collected by *Mildbraed* (No. 9040) at Kongola in April 1914 and written up by him in 1923 which I propose, tentatively, as the neotype. Other specimens at Kew include *Mildbraed* 8917 and 9179, both unlocalized, together with the following from the area of the *Flora of West Tropical Africa* :—

British Cameroons. Ngong, Bamenda, 3000 ft., in grassland, June 1931 (fl., fr.), *Maitland* 1747.

Nigeria. Nsukka, Onitsha Province, on open hillside ; " flowers greenish white " ; June 1945 (fl., fr.), *Thompson* s.n. About 3 mls. east of Mando, Zaria Province, in open *Isoberlinia tomentosa* woodland on a stony ridge ; " geophyte with knobbly tuber about 3 cms. diam., petals dull blue outside, pale green within, corona yellow "; June 1950 (fl.), *Keay* F.H.I. 25857.

Gomphocarpus filiformis *Dietr.* Syn. Pl. **2,** 900 (1840) ; Decne. in DC. Prodr. **8,** 558 (1844).

Lagarinthus filiformis (Dietr.) E. Mey. Comm. Pl. Afr. Austr. 203 (1837).

Asclepias filiformis (Dietr.) O. Ktze. in Jahrb. Königl. Bot. Gart. Berlin, **4,** 268 (1886) ; Schinz in Verh. Bot. Ver. Brandenb. **30,** 262 (1888), in adnot. ; N. E. Br. in Thiselton-Dyer, Fl. Trop. Afr. **4** (1),

336 (1902), et in Thiselton-Dyer, Fl. Cap. **4** (1), 689 (1909), incl. var. ; non Jacq. (1760), nec Linn. f. (1781).

A. buchenaviana Schinz in Verh. Bot. Ver. Brandenb. **30,** 261 (1888) ; Engl. in Engl. Bot. Jahrb. **19,** 148 (1894) ; K. Schum. in Engl. et Prantl, Naturl. Pflanzenfam. **4** (2), 238 (1895) ; N. E. Br. in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 336 (1902), in syn.

A. filiformis var. buchenaviana (Schinz) N. E. Br. in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 336 (1902), et in Thiselton-Dyer, Fl. Cap. **4** (1), 689 (1909).

This species is, apparently, confined to the Cape and South West Africa. In Southern Rhodesia its place is taken by *G. tenuifolius* (see below) and in east tropical Africa it is replaced by *G. stenophyllus* (see Bullock in Kew Bull. **1952,** 409 : 1952). All three species are characterized by their rostrate, smooth follicles with semi-membranous walls.

The name *Asclepias filiformis* is usually attributed to "Benth. et Hook. f." but they did not make the combination, although (Gen. Pl. **2,** 753 : (1876) Bentham referred *Lagarinthus filiformis* E. Mey. to *Asclepias*. The combination is illegitimate for this plant, being antedated by Jacquin (1760) and by the younger Linné (1781).

Gomphocarpus tenuifolius (*N. E. Br.*) *Bullock*, comb. nov.

Asclepias tenuifolia N. E. Br. in Kew. Bull. **1895,** 255 (1895), et in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 337 (1902).

A. rhodesica Weimarck in Botan. Notis. **1935** (No. 22), 381, ff. 9–10 (1935).

The presence or absence of a central tooth arising from the inner face of the corona-lobe, on which Weimarck relied for his separation of *Asclepias rhodesica*, is not specifically significant. I have not seen the type of Weimarck's species, but his description and figures leave no doubt that it is conspecific with *Gomphocarpus tenuifolius*.

I have some difficulty in separating this species from the east African *G. stenophyllus* Oliv. but it is of less robust growth and has smaller, fewer flowers. Further, it appears to be confined to Southern Rhodesia. Similar considerations serve to separate it from *G. filiformis* Dietr. which occurs from Hereroland through South West Africa to the Cape. Apparently all three of these species are locally abundant and all occur within the ranges of *G. fruticosus* (Linn.) Ait. f. and of *G. physocarpus* E. Mey. I have little doubt that they severally combine with the more widely distributed species to form hybrid swarms.

Gomphocarpus amabilis (*N. E. Br.*) *Bullock*, comb. nov.

Asclepias amabilis N. E. Br. in Kew Bull. **1895,** 70 (1895), et in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 338 (1902) ; K. Schum. in Engl. Pflanzenw. Ost Afr. **C,** 425 (1895).

This species was described from two specimens (*Carson* 35, 55) collected in the Fwambo area of northeastern Northern Rhodesia. It is of some interest to note that recent collections have extended its known range to the northwestern corner of Northern Rhodesia and to the Ufipa plateau in southwestern Tanganyika :—

Tanganyika Territory. Chapota, Ufipa District, 5500 ft., among mbuga grasses ; " plants always solitary ; erect [about 12 ins.] inflorescence nodding, petals brown outside, white inside, corona white " ; 5 Dec. 1949 (fl.), *Bullock* 2062.

Northern Rhodesia. Kalenda Plain, north of Matonchi Farm, Mwinilunga District, in shallow boggy soil overlying laterite in open ; " perennial with tuberous roots wedged in cracks of laterite, leaves narrow, rather dull green ; calyx and pedicel greenish purple, perianth segments pale greenish cream inside, suffused dull purple outside, corona ditto, column cream, suffused dull purple " ; 8 Dec. 1937 (fl.), *Milne-Redhead* 3556. (Mr. Milne-Redhead obtained additional material, some of which is preserved in spirit, on 12 Dec. 1937, no. 3556A).

Stenostelma *Schltr.*

I have already (Kew Bull. **1952,** 417) resuscitated Schlechter's generic name *Stenostelma* to replace the *Krebsia* Harv. (non Eckl. et Zeyh.) of the *Flora Capensis* and I now refer the following species to it, thereby extending the range of the genus to tropical Africa.

Stenostelma eminens (*Harv.*) *Bullock*, comb. nov.

Gomphocarpus eminens Harv. Thes. Cap. **2,** 60, t. 195 (1863) ; Schltr. in Engl. Bot. Jahrb. **18,** Beibl. No. 45, 18 (1894) et *l.c.* **20,** Beibl. No. 51, 29 (1895).

Asclepias eminens (Harv.) Schltr. in Journ. Bot. **34,** 453 (1896), et in Ann. Naturhist. Hofmus. Wein, **15,** 67 (1900) ; N. E. Br. in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 351 (1902), et in Thiselton-Dyer, Fl. Cap. **4** (1), 685 (1908).

There is at Kew a fair number of gatherings of this species from Natal, Orange Free State and the Transvaal ; there are also three gatherings from Southern Rhodesia, the following being additional to those recorded by N. E. Brown for tropical Africa in 1902 :—

Southern Rhodesia. Gwelo, Jan. 1905 (fl.), *Gardner* ex *Barthelemy* 52. Near Salisbury, Dec. 1911 (fl.), *Craster* 94.

Stathmostelma *K Schum.*

In Kew Bull. **1953,** 52–57, I transferred a number of species which Brown had placed in *Asclepias* to this genus, and described two new ones. The following notes deal particularly with the specific differentiation of *S. pedunculatum* from *S. rhacodes*, together with certain species described from the Belgian Congo and a third new one from east Africa which was formerly confused with *S. gigantiflorum*.

Stathmostelma pedunculatum (*Decne.*) *K. Schum.* in Engl. Bot. Jahrb. **17,** 132 (1893), in clavi, et in Abh. Preuss. Akad. Wiss. Berlin, **1894,** 24, 41 (1894), et in Engl. Pflanzenw. Ost Afr. **C,** 322 (1895), et in Engl. Bot. Jahrb. **28,** 456 (1900) ; De Wild. in Ann. Mus. Congo, Sér. 5, **1,** 189 (1906) ; Durand, Syll. Fl. Congol. 361 (1909) ; Schltr. in Notizbl. Bot. Gart. Berlin, **9,** 28 (1924).

Gomphocarpus pedunculatus Decne. in DC. Prodr. **8,** 558 (1844) ; A. Rich. Tent. Fl. Abyss. **2,** 40 (1851).

Asclepias macrantha Hochst. in Flora, **27,** 101 (1844), nomen ; Oliv. in Trans. Linn. Soc. **29,** 111, t. 75 (1875), descr. ; N. E. Br. in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 340 (1902).

Pachycarpus corniculatus Hochst. in Flora, **27,** 101 (1844), nomen.

Gomphocarpus longipes Oliv. in Trans. Linn. Soc. **29,** 111, t. 75 (1875), ubi errore ; Engl. Hochgebirgsfl. Trop. Afr. 342 (1892).

Stathmostelma globuliflorum K. Schum. in Engl. Pflanzenw. Ost Afr. **C,** 322 (1895).

S. macranthum (Hochst. ex Oliv.) Schltr. in Notizbl. Bot. Gart. Berlin, **9,** 27 (1924), quoad syn.

Asclepias pedunculata (Decne.) Dandy in Andrews, Fl. Pl. Anglo-Egypt. Sudan, **2,** 401 (1952), quoad syn. ; Dandy in Kew Bull. **1953,** 108 (1953).

Although there has never been any formal reduction of *Stathmostelma rhacodes* K. Schum. (see, below, p. 344) to this species, there has been some confusion between them and a tendency to regard the two as synonymous. Schlechter (1924) clearly distinguished two species, but he unfortunately chose the epithet *macranthum* for specimens of *S. rhacodes*. My attention was focussed on this problem by Mr. B. Verdcourt, who collected both species and provided the following notes :—

S. pedunculatum (No. 422)
Herb to 9 ins. from fairly stout rootstock (like thumb) with narrow deep green purple-tinged leaves. Petals salmon-red internally, yellowish at base and brownish at apex externally. Coronal lobes rose pink with tips orange yellow. Stigmatic surface orange crimson with yellowish margin. Infrequent in Thika Road House Grasslands (4 miles north of Nairobi on Thika Road). Flowers in dry weather, but often only one plant to be found. Jan.–March, 1951.

S. rhacodes (No. 436)
Very like 422 when dry but quite distinctive when alive. Flowers much bigger with orange salmon petals. Coronal lobes yellow, very shiny below, tips bright orange. Tuberous roots to 1 in. diam. One only seen in Thika Road Grasslands. Feb. 1951.

In spite of Mr. Verdcourt's notes, it remained impossible to distinguish between the two species by casual inspection of the dried herbarium material and it became necessary to dissect all the Kew material.

This work, and the labour of making sketches of coronal lobes, pollinia and pollen carriers, has been carried out on my behalf by Miss P. Halliday, and I wish to record my indebtedness to her. The differences between the two species, in both the coronal lobes and in the pollen carriers, are illustrated in the accompanying drawings. Having separated the Kew herbarium material according to these characters, a somewhat subtle difference in general facies, of the same nature as is indicated in Mr. Verdcourt's notes on living material, becomes apparent.

The geographical and altitudinal ranges of *S. pedunculatum* are very much more extensive than in the case of *S. rhacodes*. As shown below, *S. rhacodes* is confined to Kenya Colony and its range in altitude is from about 5000 7500 ft. *S. pedunculatum* on the other hand, is found from near sea level up to about 6000 ft. in Abyssinia, Uganda, Kenya (eastern) Tanganyika and Portuguese East Africa. I have not seen the specimens recorded for the Congo. Like *S. rhacodes*, it is a plant of seasonal swamp grasslands.

S. pedunculatum shows considerable variation in flower size, but its flowers are always smaller than those of *S. rhacodes*. The altitude notes attached to specimens are not complete, but so far as they go there is a

strong indication that flower size generally increases with increasing altitude and at the upper limit, where in Kenya the distribution overlaps that of *S. rhacodes*, there is often little difference in size between them. At lower elevations the flowers may be little more than half the size at the upper limit.

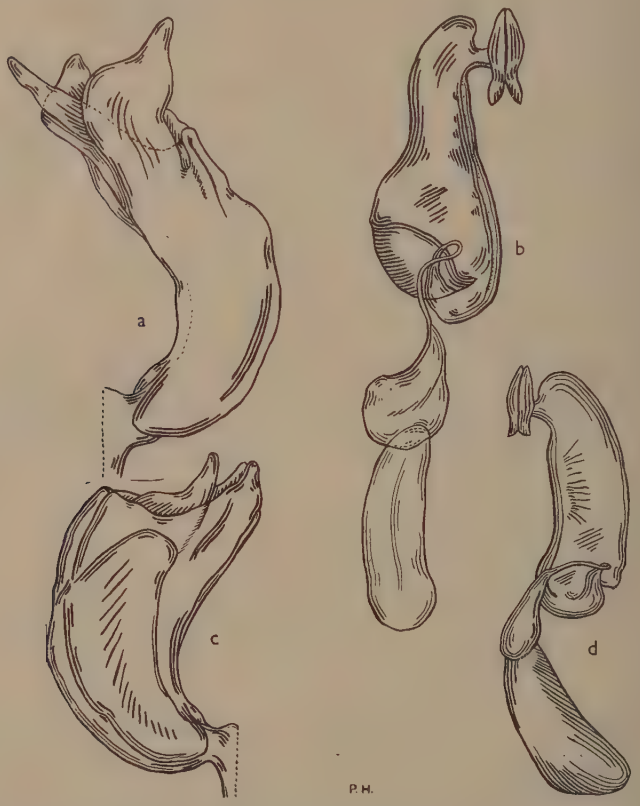


Fig. 2. Corona-lobes (× 7·5) and pollen-carriers (× 30) of *Stathmostelma rhacodes* K. Schum. (a, b) and *S. pedunculatum* (Decne.) K. Schum. (c, d).

Stathmostelma rhacodes *K. Schum.* in Engl. Bot. Jahrb. **17,** 131, t. 6 D–F (1893), et in Engl. Pflanzenw. Ost Afr. **C,** 322 (1895), et in Engl. et Prantl, Naturl. Pflanzenfam. **4** (2), 240 (1895).

Asclepias rhacodes (K. Schum.) N. E. Br. in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 342 (1902).

[*Stathmostelma pedunculatum* (non (Decne.) K. Schum.)—Schltr. in Journ. Bot. **33,** 335 (1895)].

[*S. macranthum* (non (Hochst. ex Oliv.) Schltr.)—Schltr. in Notizbl. Bot. Gart. Berlin, **9,** 27 (1924), quoad spec. cit.].

[*Asclepias macrantha* (non Hochst. ex Oliv.)—Bullock in Kew Bull. **1933,** 79 (1933).]

This species is apparently confined to the swampy grasslands of Kenya Colony ; the Kew material is listed below and I have also examined the specimens in the British Museum herbarium. Collector's notes show that its altitudinal range is from about 5000 to 7500 ft. and that it usually flowers from December to March and again in July. I have seen one record of an April and one of a May flowering. Notes on flower colour are often inadequate (those of Mr. Verdcourt given above on page 343 are the best available) and are often unreliable owing to confusion with *S. pedunculatum* (Decne.) K. Schum.

Kenya Colony. Near Nairobi : *Verdcourt* 422, *Napier* 58, *Battiscombe* 468, *Dowson* 164 ; Athi Plains, *Scott Elliot* 6499 ; Londiani, *Gilbert Rogers* 514, *Baker* 351, *Honoré* 217 ; Kitale, *Wiltshire* 20 ; Mau Plateau—Nandi—Mumias—Lubwas (Kavirondo), *Whyte* s.n. (three gatherings) ; Nakuru, "*R.H.*" 1 ; Chepalungu, Sotik, *Gardner* 2515 ; Mt. Elgon, *Lugard* 282 ; without locality, *Brodhurst-Hill* 305, *Lankester* s.n.

Stathmostelma welwitschii Britt. et Rendle in Trans. Linn. Soc. Ser. 2, Bot. **4,** 28 (1894) ; Hiern in Cat. Afr. Pl. Welw. **1,** 687 (1898).

Asclepias welwitschii (Britt. et Rendle) Britt. et Rendle, *l.c.* in obs., nom. provis. ex N.E. Br. in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 341 (1902) ; Norman in Journ. Bot. **67,** Suppl. 2, 93 (1929).

Stathmostelma laurentianum Dewèvre in Bull. Soc. Bot. Belg. **33** (2), 102 (1895), nomen, et *l.c.* **34** (2), 87 (1895) ; Durand et Schinz, Études Fl. Congo, **1,** 194 (1896) ; Durand, Syll. Fl. Congol. 361 (1909).

Asclepias laurentiana (Dewèvre) N. E. Br. in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 342 (1902).

Stathmostelma chironiodes K. Schum. ex De Wild. et Durand in Bull. Herb. Boiss. Sér. 2, **1,** 829 (1901) ; De Wild. in Ann. Mus. Congo, Sér. 5, **1,** 305 (1906) ; Durand, Syll. Fl. Congol. 361 (1909) ; nomen tantum. Bullock in Kew Bull. **1952,** 416 (1952), in syn. dub.

[*Asclepias macrantha* (non Hochst.)—N. E. Br. in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 340 (1902), partim, quoad spec. Schweinf. No. 3956 cit., non *Stathmostelma pedunculatum* (Decne.) K. Schum.].

A. bagshawei S. Moore in Journ. Bot. **46,** 296 (1908).

Although N. E. Brown admitted *Asclepias welwitschii* as a species in the *Flora of Tropical Africa*, he failed to identify with it Schweinfurth's specimen from the southern Sudan, which he placed with his *Asclepias macrantha* Hochst., a plant from Abyssinia and now to be known as *Stathmostelma pedunculatum* (Decne.) K. Schum. Brown did not see *S. laurentianum* Dewèvre and maintained it as a distinct species, though the description gives a very strong indication of its real identity. By the courtesy of Dr. W. Robyns I have been able to examine the type of *S. laurentianum* and specimens of *S. chironiodes* and am unable to separate them from *S. welwitschii*, which was formerly thought to be confined to Angola. I have now seen specimens from the southern Sudan, the West Nile province of Uganda, northwestern and southwestern Tanganyika, southern Belgian Congo, the extreme south of Northern Rhodesia and Angola. I am unable to agree with S. Moore's specific differentiation of *Asclepias bagshawei*, which was collected by *Bagshawe* in the southern Sudan, not Uganda.*

*I am indebted to Miss L. Fletcher for the preparation of the distribution maps.—A.A.B.

Collectors' notes are meagre, but all are agreed on the yellow colour of the flowers. The plant occurs in seasonally waterlogged grassland and the writer found it in such a situation on the Ufipa Plateau of southern Tanganyika about the middle of the rainy season. The following specimens have been seen :—

Sudan. Edge of Azza forest, *J. G. Myers* 6555. Near Ibba River, *Schweinfurth* 3956. Rei, *Schweinfurth* 3923. Yei River, Lado, *Silitoe* 451. Bari, *Bagshawe* 1640.

Uganda. West Nile Province : Koboko, *Purseglove* 1045 ; *Hazel* 468 ; Adumi, *Eggeling* 4261.

Tanganyika. Chala–Kisi, Ufipa Plateau, *Bullock* 2251. Mwanza, *Rounce* 247. Geita–Karumo road, between Mazinda and Ibanda camps, *Burtt* 6505.

Belgian Congo. Kisantu, *Gillet* s.n.Kimpesse, *Demeuse* 5. Bas Congo, *Laurent* s.n.

Northern Rhodesia. Livingstone, *Rogers* 7260.

Angola. Malange, *Gossweiler* 1130, 1131. Pungo Andongo, *Welwitsch* 4168 (holotype in Herb. Mus. Brit.). Seventy miles from Ambriz, *Monteiro* s.n.

Fig. 3. The known distribution of *Stathmostelma welwitschii* Britt. et Rendle.

Stathmostelma verdickii *De Wild.* in Ann. Mus. Congo, Sér. 5, **1,** 188 (1904), non De Wild. *l.c.* 305 (1906), nom. provis. in obs.

Asclepias verdickii De Wild. *l.c.* 188, in syn., nom. provis., non *A. verdickii* De Wild. *l.c.* 305 (1906).

So far as I am aware, only the type specimen of this species, deposited in the Brussels herbarium, is known. By the courtesy of Dr. W. Robyns

I have been able to examine it and find it to be very closely allied to *S. welwitschii* Britt. et Rendle. The most striking difference from that species is in the long pilose indumentum of stems, leaves, calyces and corollas of *S. verdickii*. The calyx segments are relatively longer and narrower. Pending examination of further material, I regard the species as of uncertain status. De Wildeman differentiated it on the one hand from *S. gigantiflorum* K. Schum. and on the other from *Asclepias integra* N. E. Brown. Its affinity, however, is not with either of those species but, as indicated above, with *S. welwitschii*. It was collected at Lukafu, Belgian Congo, by *Verdick* (No. 361) in February, 1900. A photograph of the type is deposited in the Kew herbarium (Kew negative No. 1004).

Stathmostelma wildemanianum *Durand*, Syll. Fl. Congol. 361 (1909).

Asclepias verdickii De Wild. in Ann. Mus. Congo, Sér. 5, **1,** 305 (1906), non *Stathmostelma verdickii* De Wild. *l.c.* 188 (1904).

Stathmostelma verdickii De Wild. *l.c.* 305 (1906), nom. provis. in obs., non De Wild. *l.c.* 188 (1904).

By the courtesy of Dr. W. Robyns, I have been able to examine the type of this species, collected by *Verdick* (No. 1899) at Lofoi in the Belgian Congo. It belongs to the group of species allied to *S. gigantiflorum* K. Schum. and is nearest to *S. fornicatum* (N. E. Br.) Bullock but differs from them in having the apices of the corona-lobes truncate and toothed, which gives the corona a cristate appearance. The corolla, when opened out, is about 3 cms. in diameter and the corona-lobes, arising 4 mm. from the base of the gynostegium, are just over one centimetre long. The pedicels, 7·5–9·5 cm. long, are longer than in any other species known to me. There is now a photograph (Kew negative No. 1005) of the type in the Kew Herbarium.

Stathmostelma praetermissum *Bullock*, sp. nov. a *S. gigantifloro* K. Schum. floribus minoribus, calyce lobis lanceolatis, coronae lobis minoribus apice adaxialiter utrinque rostris erectis extrorsus curvatis majoribus praeditis recedit ; *S. nomadacridum* Bullock valde affinis sed coronae lobis apice truncatis haud abaxialiter elongatis acutis distincta.

Herba perennis, geophytica, caulibus glabrescentibus quadrangularibus ramosis usque 1 m. altis e radice tuberoso magno 15 cm. longo ortis. *Folia* graminiformia, erecta vel adscendentia, circiter 20 cm. longa et 1 cm. lata, apice acuta, basi gradatim angustata, petiolis obsoletis, utrinque glabra. *Flores* magni in umbellas pedunculatas 3–5-floras dispositi ; pedunculi usque 20 cm. longi, erecti, terminales sed habitu sympodiales velut ex axillis foliorum superiorum orti ; bracteae linearisubulatae saepe circiter 1 cm. longae sed interdum majores vel rarius subfoliaceae ; pedicelli circiter 4 cm. longi, erecto-radiatim dispositi. *Calyx* fere ad basin 5-partitus ; lobi lanceolati, acuti, circiter 6–9 mm. longi et 3–4 mm. lati, extra parce crispato-pilosi. *Corolla* alba, rotata, circiter 5 cm. diametro ; lobi ovato-lanceolati, acuti, 2·4 cm. longi, 1 cm. lati, utrinque glabri, marginibus recurvis. *Coronae lobi* virides, purpureomaculati, complicati, ambitu plus minusve quadrangulares, 9 mm. alti, superne 4 mm. lati, margine abaxiale arcuato, marginibus superioribus

horizontalibus adaxialiter rostris 2 albidis purpureo maculatis erectis extrorsus curvatis ornatis, intus exappendiculati. *Folliculi* maturi ignoti, juniores fusiformes, solitarii, albido-tomentelli.

[*Stathmostelma gigantiflorum* (non K. Schum.) ; Schltr. in Journ. Bot. **33,** 333 (1895).]

[*Asclepias gigantiflora* (non (K. Schum.) N. E. Br.) ; N. E. Br. in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 326 (1902), quoad spec. Scott-Elliot. cit.]

Kenya Colony. Makindu Mts., Nov. 1893 (fl.) *Scott-Elliot* 6283. Kiambere, Machakos District, Nov. 1951 (fl.), *Kirrika* 133. Mabuleni, near Thika, in black cotton soil ; " herb to 3 ft., corolla white, calyx green, corona green, speckled purple, the inner tips pale whitish purple " ; Dec. 1952 (fl., young fr.), *Verdcourt* 844 (collected by Mrs. L. D. Verdcourt and Mr. Delap). Yatta Plateau, near Moboloni Rock, 3800 ft., in black soil grassland ; " root tuberous, herb to 50 cm. high, flowers 5 cm. diam., corolla creamy white, corona green flecked with pale purple, inner horns white with purple dots"; Dec. 1952 (fl.), *Bally* 8380 (with flowers in spirit) (*holotypus in herb. Kew.*). *Bally* 8379, from the same locality, belongs here, but shows only buds.

Tanganyika Territory. Kikori, 4200 ft., local in *Acacia formicarum* woodland, on black soil, April 1930 (fl.), *Burtt* 2726A.

As noted in the specimens enumerated, this species was first collected by *Scott-Elliot* in 1893, but his specimen was misidentified by Schlechter (1895). N. E. Brown (1902), who doubtless relied on Schlechter's determination, drew up his description of *Asclepias gigantiflora* largely from the *Scott-Elliot* specimen, but took the longer measurements from K. Schumann's (1893) original description. In my treatment of *S. gigantiflorum* K. Schum. (*antea* p. 52) the reference to Schlechter (1895) should be deleted and the final paragraph of the discussion modified in the sense indicated above.

The *Scott-Elliot* specimen at Kew is a poor one, but the other material quoted is in excellent condition. I am particularly glad to have been able to examine Mr. P. R. O. Bally's spirit material, in which the size and shape of the coronal lobes are exactly preserved.

Stathmostelma nomadacridum *Bullock* in Kew Bull. **1953,** 53 (1953).

I have now identified the following additional specimens :—

Tanganyika Territory. Kazikazi, Manyoni District, 4200 ft., in wet boggy soil, rare, April 1933 (fl.), *Burtt* 4657. Msalala, in marshes ; " striking ornamental flower : large tuber 6 ins. long : used medicinally by natives " ; Feb. 1933 (fl.), *Rounce* 245. Shinyanga, 3900 ft., in hard-pan grassland, rare, Feb. 1935 (fl.), *Burtt* 5154. Huruhuru mbuga, Shinyanga, 3800 ft., in black cotton soil with *Setaria holstii*, rare ; " large flowers, pale greenish-yellow tinged with lilac ; " Jan. 1936 (fl.), *Burtt* 5585. *Shinyanga,* in fairly open marshy ground, Feb. 1933 (fl.), *Bax* 182. Katisunga, Mpanda District, 3500 ft., in wet black cotton soil of wooded grassland ; " suberect, flowers greenish, the petals and corona spotted purple ; " Jan. 1950 (fl.), *Bullock* 2270.

Trachycalymma *Bullock*, gen. nov.

Trachycalymma *Bullock*, gen. nov. *Gomphocarpo* R. Br. affinis sed coronae lobis plus minusve semiglobosis carnosis non complicatis nec lateraliter compressis, superne profunde concavis intus pilis erectis papilliformibus cristatis floribus plus minusve anthocyaneo-coloratis differt.

Herbae perennes, geophyticae, statura mediocres, plus minusve hirsutae, radicibus fusiformibus, caulibus subsimplicibus e basi lignoso saepe tuberoso ortis. *Folia* opposita, linearia vel anguste lanceolata usque late

ovata. *Flores* in umbellas paucifloras pedunculatas ex axillis foliorum superiorum ortas dispositi. *Folliculi* anguste fusiformes, longe stipitati vel (species unica) exstipitati et latiores, laeves vel (species unica) molliter echinati.

Species 4–5, *in Africa australi et tropicali crescentes.*

The name *Trachycalymma* was coined by K. Schumann (in Engl. et Prantl, Naturl. Pflanzenfam. **4** (2), 236 : 1895) to designate a subsection of *Gomphocarpus* sect. *Eugomphocarpus* Decne., which he established to accommodate those species whose corona-lobes are conspicuously papillate or provided with a crest of papilliform hairs on the inner face. He included *Gomphocarpus cristatus* Decne. and *G. paluster* K. Schum., which N. E. Brown treated as conspecific under *Asclepias palustris* (Decne.) Schltr. in the *Flora of Tropical Africa* (1902). The differences found by Schumann, Schlechter, Brown and Spencer Moore in the corona lobes between their various " species " are largely developmental. At first the lobes are in effect fleshly tubercles on the staminal column ; later the uppermost adaxial portion grows outwards and the upper edges separate to reveal the papillae of the inner face ; finally the separated edges become horizontal. After anthesis the papillae begin to degenerate and when very old flowers are dissected they may be thought to be absent. The abaxial horn or tongue, when present, is very variable and its size is perhaps no more than an expression of the vigour of the plant.

Trachycalymma cristatum (*Decne.*) *Bullock*, comb. nov., typus nominis generici.

Gomphocarpus cristatus Decne. in Ann. Sc. Nat. Sér. 2, **9,** 325, t. 11D, f. 3 (1838), et in DC. Prodr. **8,** 562 (1844) ; K. Schum. in Engl. et Prantl, Naturl. Pflanzenfam. **4** (2), 236 (1895) ; De Wild. in Ann. Mus. Congo, Sér. 5, **1,** 184 (1904).

G. paluster K. Schum. in Engl. Bot. Jahrb. **17,** 127 (1893) ("*palustris*"), et in Engl. et Prantl, Naturl. Pflanzenfam. **4** (2) 236 (1895), et in Engl. Bot. Jahrb. **30,** 382 (1901) ; De Wild. in Ann. Mus. Congo, Sér. 5, **1,** 184 (1904).

Asclepias palustris (K. Schum.) Schltr. in Journ. Bot. **33,** 336 (1895) ; Hiern in Cat. Afr. Pl. Welw. **1,** 686 (1898) ; N. E. Br. in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 349 (1902) ; Norman in Journ. Bot. **67,** Suppl. 2, 94 (1929).

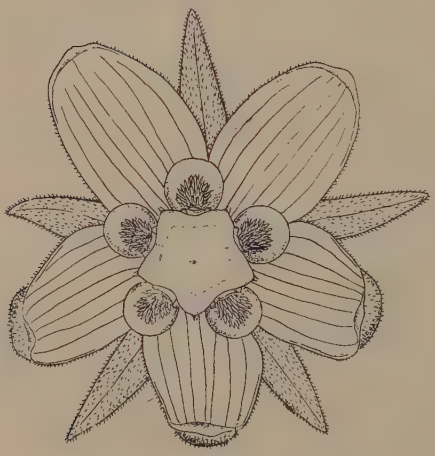
A. cristata S. Moore in Journ. Bot. **50,** 343 (1912) ; Norman in Journ. Bot. **67,** Suppl. 2, 94 (1929).

A. kyimbilae Schltr. in herb. Stolz. No. 502, nomen.

The type of this species was collected in Angola, but I have now seen additional material from that country as well as from Northern Rhodesia, Southern Rhodesia, Nyasaland, Moçambique, Tanganyika, Uganda, Nigeria and British Cameroons. There are, however, big gaps in the known distribution and further gatherings from all areas would be very welcome additions to the Kew collections.

It may be noted that S. Moore (1912) described his *Asclepias cristata* as a new species which he placed near *Asclepias palustris*. K. Schumann (1893) adopted the spelling " *palustris* " for his new species ; he changed

the spelling to "*paluster*", which is more accurate, in 1901. N. E. Brown (1902) first realised that *Gomphocarpus cristatus* and *G. paluster* are conspecific, and he adopted the combination *Asclepias palustris* (K. Schum.) Schltr. under the "Kew" rule then in force.



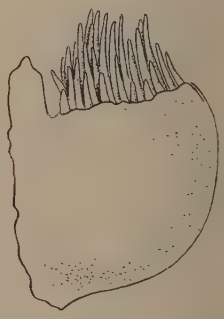


FIG. 4. *Trachycalymma pulchellum* (Decne.) Bullock ; a, open flower from *Keay* 25885, × 4 ; b, corona-lobe of the same, side view, × 12.

FIG. 5. *T. cristatum* (Decne.) Bullock ; a, open flower from *Milne-Redhead* 3079, × 4 ; b, corona-lobe of the same, side view, × 12.

Trachycalymma pulchellum (*Decne.*) *Bullock*, comb. nov.

Gomphocarpus pulchellus Decne. in Ann. Sc. Nat. Sér. 2, **9,** 325 (1838), et in DC. Prodr. **8,** 558 (1844).

G. amoenus K. Schum. *l.c.* 124, et in Bull. Soc. Bot. Belg. **37,** 122 (1898) ; non *Asclepias amoena* Linn. (1753), nec Brongn. (1831).

G. foliosus K. Schum. in Engl. Bot. Jahrb. **17,** 126 (1893) ; Durand et Schinz, Études Fl. Congo, **1,** 193 (1896).

G. roseus K. Schum. *l.c.* 127 ; Durand et Schinz, *l.c.* ; non *Asclepias rosea* Roxb. (1814), nec H. B. K. (1819).

Asclepias foliosa (K. Schum.) Hiern in Cat. Afr. Pl. Welw. **1,** 686 (1898) ; N. E. Br. in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 349 (1902) ; Hutch. et J. M. Dalz. Fl. W. Trop. Afr. **2,** 56 (1931).

A. schumanniana Hiern, *l.c.* ; N. E. Br. *l.c.* 346 ; De Wild. in Ann. Mus. Congo, Sér. 5, **1,** 188 (1904) ; Norman in Journ. Bot. **67,** Suppl. 2, 93 (1929).

A. pulchella (Decne.) N. E. Br. in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 349 (1902) ; Norman in Journ. Bot. **67,** Suppl. 2, 94 (1929).

A. rubella N. E. Br. *l.c.* 348.

A. modesta N. E. Br. *l.c.*

A. gossweileri S. Moore in Journ. Bot. **49,** 155 (1911).

A. lepida S. Moore, *l.c.* **50,** 344 (1912) ; Norman in Journ. Bot. **67,** Suppl. 2, 94 (1929).

A. ameliae S. Moore, *l.c.* 345 ; Norman, *l.c.*

A. endotrachys Schltr. in Engl. Bot. Jahrb. **51,** 137 (1913).

K. Schumann (1895) described five of the species here united ; N. E. Brown (1902), differing from both Schumann and Hiern (1898) in some identifications, recognised six species, some of which he knew only from the original descriptions.

The characters used by Brown in his key to the species are shown, by the more abundant material now available, to be of no differential value. The exact position of the corona in relation to the base of the gynostegium depends to a great extent on the physiological age of the flower and probably also on the vigour of the plant. Flower colour varies from white (with or without coloured veins) to pink or rose with more deeply coloured veins. As usual, collectors' notes on colour and the exposure of the habitat are incomplete, but so far as they go there is no geographical or other correlation. It may be assumed that flower colour tends to fade with age, and to be deeper in shady situations. Other characters mentioned by Brown in his descriptions refer to the relative lengths of lateral and central appendages of the coronal lobes and the exact position, form and size of the papilliform hairs forming the crest on the internal face. These characters vary from flower to flower and according to age on the same plant, whilst the drying method adopted in the field—particularly the pressure used—also affects the facility of observation of these characters. Pubescence of the corolla lobes, especially of the outer face, is variable in quantity but not in quality. I find the character unreliable and have been unable to correlate it with any other variation. The flattened, scale-like appearance of the coronal papillae described for *Asclepias schumanniana* is probably an artefact and Brown himself was doubtful of the specific separation of that species.

The following specimens are preserved at Kew in addition to those cited by Brown (1902), from southern Tanganyika, Nyasaland, Angola and southern Belgian Congo.

Northern Nigeria. Naraguta ; 23 June 1921 (fl., fr.), *Lely* 317. Bauchi Plateau ; June, 1930 fl. , *Lely* P.341. Vom, Bauchi Plateau, 3000–4500 ft. ; "six inches high, flowers white" ; *Dent Young* 172. Kan Gimi, between Rest House and Bahago R., Anara forest reserve, Zaria Province, in open savannah woodland with *Isoberlinia doka* ; "erect herb with carrot-like tap root about 4 cm. long ; leaves and stem pale green with whitish almost sea-bird hairs ; pedicels and calyx-lobes purplish ; corolla white, corona very pale green" ; 8 May 1948 fl. , *Keay* 22915.* Gavam, Mando F.R., Gwari District, Zaria Province, in open *Monotes-Detarium-Lophira* savannah woodland ; "erect herb, flowers white" ; 2 June 1950 fl. , *Keay* 25816.* Near Rabo'utu R., Gwari District, Zaria Province, in *Butyrospermum-Isoberlinia tomentosa* open savannah on eroded slope ; "erect herb with small carrot-like tuber ; calyx green, corolla white, corona-lobes pale green with white margins" ; 20 June 1950 fl., with additional spirit material), *Keay* 25885.*

Cameroons. Kumre-Babua about 3000 ft. ; 4 May 1914 fl. , *Mildbraed* 9250a. Buar c. N. 15 35 E., about 3800 ft. ; May 1914 fl. , *Mildbraed* 9352. Bosum-Buar (about) 3000 ft. ; (end of) June, 1914 (fr.), *Mildbraed* 9727.

Tanganyika Territory. Nshamba, Bukoba District, in alluvial grass thicket ; "herb, mauve flowers" ; Sept.–Oct. 1935 (fl.), *Gillman* 544. Kyimbila District ; *Stolz* K.28.

Portuguese East Africa. *Johnson* 467, 471.

Northern Rhodesia. Mumbwa, *Macaulay* 821, 821a. Mwinilunga, 4500–5000 ft., in bush ; "clusters of white cup-like flowers with raised centres" ; Nov. (fl., young fr.), *Marks* 50.

Belgian Congo. Elisabethville ; 22 Oct. 1911 (fl.), *Rogers* 154.

There is little doubt that this plant will be found in Uganda and the Sudan, thereby completing a savannah distribution now recognised as being "normal".

Trachycalymma fimbriatum (*Weimarck*) *Bullock*, comb. nov.

Asclepias fimbriata Weimarck in Botan. Notis. **1935** (No. 22), 378, ff. 7 g–m, 8 (1935).

Weimarck compared this species, vegetatively, with *Asclepias spectabilis* and *A. pachyclada*, both of which I have (Kew Bull. **1953,** 56 : 1953) placed under *Stathmostelma spectabile* (N. E. Br.) Schltr. I have not seen the type, but Weimarck's excellent description and figures leave no doubt that it is identical with the following specimens in the Kew herbarium :—

Southern Rhodesia. Invanga : 6000 ft., Oct. 1935 fl. , *Eyles* 8460 ; Pungwe Hills, 6000 ft., Nov. 1944 fl., young fr. , *Hopkins* Govt. Herb. Salisbury No. 13137 ; Pungwe Hills, on granite, 6000 ft., Nov. 1945 fl., young fr. , *Hopkins* (Govt. Herb. Salisbury No. 13832) ; open grassland, 6700 ft., Oct. 1946 fl. , *Wild* 1365.

All these specimens were collected very near to the *locus classicus* where it was found by *Fries, Norlindh* and *Weimarck* (No. 3748) in December 1930.

Baseonema *Schltr. et Rendle*

Baseonema gregorii *Schltr. et Rendle* ; Bullock in Kew Bull. **1953,** 64 (1953).

Since recording this species from Tanganyika, I have discovered in the Kew herbarium a further excellent specimen mounted on two sheets, collected by Mr. H. M. Gardner, which had been laid away as an undetermined species of another genus. This shows very well the twining habit exhibited by the *Kässner* specimen in the British Museum herbarium, and it bears flowers and a single immature follicle. Further additional material has also been received at Kew, two gatherings by Mr. P. R. O. Bally with flowers and half-grown fruit and a similar one by Dr. van Someran. The follicles are horizontally opposed, or even reflexed, about

*Mr. Keay's numbers quoted here and elsewhere are those of the Forestry Department Herbarium, Ibadan.—A.A.B.

9 cm. long and about 1·5 cm. diam. at the middle, gradually narrowed to an obtuse apex, and somewhat narrowed to the base.

Kenya Colony. Lower Ukamba, Yatta Plateau, 4000 ft. growing on shrubs amongst piles of rocks ; " climber, flowers green and yellow " ; Jan. 1937 (fl., young fr. , *Gardner* 3612. Namanga, in river bed ; " climber " ; April, 1938 (fl.), *Bally* 7316. Ithaba swamp, 3000 ft., in bush country ; " climber " ; May, 1938 (fl., young fr.), *Bally* 7918 Garabani valley, 4900 ft., in donga; March, 1940 fl., young fr.,, *van Someren* 184.

Raphionacme *Harv.*

Raphionacme grandiflora *N. E. Br.* in Kew Bull. **1895,** 111 (1895), et in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 270 (1902) ; K. Schum. in Engl. Pflanzenw. Ost Afr. **C,** 425 (1895).

Of the two specimens cited by Brown (1895, 1902), that collected by *Carson* (No. 5) in 1890 is much the better and is here designated as the lectotype. The other specimen cited is much less hairy and has smaller flowers than Carson's plant. It is exactly matched by a specimen recently collected by Mrs. Faulkner in Portuguese East Africa, whilst the type specimen has been matched by another collected by Mrs. Richards. In view of the geographical separation of the two forms, it seems worth while to give them subspecific names as follows :—

1. **R. grandiflora** *N. E. Br.* subsp. **grandiflora.**

Northern Rhodesia. Niomkolo (southern edge of Lake Tanganyika), *Carson* 5 (*lectotypus in herb. Kew.*). Kumbula Is., Lake Tanganyika, 2900 ft., in woodland on very poor soil ; " herbaceous plant, calyx, leaves and stem having a few (*sic*) white hairs, corolla stiff, purplish at the base, green outside, blue purple inside, green tips turned back "; Dec. 1951 (fl.), *Richards* 185.

2. **R. grandiflora** *N. E. Br.* subsp. **glabrescens** *Bullock*, subsp. nov. a typo omnibus partibus levissime hirsutis haud albido-pilosis, floribus plane minoribus differt.

Nyasaland. Near Blantyre, Shire Highlands, *Last* s.n.

Moçambique. Moebede, Lugela, Mocuba, Quelimane District, 200–400 ft., "collected on a motor trip 30 miles from the plantation ", 1944, *Faulkner* 7, ex herb. Pretor. (*holotypus subspecei in herb. Kew.*).

Xysmalobium *R. Br.*

The new synonymy listed in Kew Bull. **1952,** 413–414, for *X. undulatum* (Linn.) Ait. f. is still further increased in the note below. Although I have not yet seen all the species described under *Xysmalobium*, I am now convinced that the genus should be regarded as monotypic and that all species not conspecific with *X. undulatum* should be transferred to other genera.

Xysmalobium undulatum (*Linn.*) *Ait. f.* ; Bullock in Kew Bull. **1953,** 413 (1952).

? *Woodia trilobata* Schltr. in Journ. Bot. **33,** 337 (1895).

? *Xysmalobium trilobatum* (Schltr.) N. E. Br. in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 306 (1902).

X. dispar N. E. Br. *l.c.* 307 ; Weimarck in Botan. Notis. **1935** (No. 22), 368 (1935).

X. amplifolium Weimarck, *l.c.* 369, ff. 3, 4a–e.

X. dilatatum Weimarck, *l.c.* 370, ff. 4f–k, 5.

Schlechter's species is known only from the type gathering from the Kavirondo district (*Scott-Elliot* 6877) ; N. E. Brown (1902) showed that Schlechter's diagnostic feature—a three-lobed corona—was in fact an artefact and he relied on the smaller size of the flowers and the glabrous inner face of the corolla lobes to separate it from its allies, most of which I have already (1952) reduced to the synonymy of *X. undulatum*. In this case I believe the specimen to be a *chimaera*. The flowers, in addition to being smaller than in typical *X. undulatum*, are more numerous and are borne on very slender pedicels ; the inflorescences give the impression of being diseased. The leaves are indistinguishable from those of *X. undulatum*.

Weimarck provides very accurate descriptions of his new species and gives the details by which he separates them from each other, from *X. dispar* and from *X. undulatum*. In the long series of specimens at Kew and the British Museum, I have observed all these differences, but they are rarely to be found in the same specimen and I have concluded that Weimarck's names must be added to the synonymy I have already proposed.

Kanahia *R. Br.*

Kanahia laniflora (*Forssk.*) *R. Br.* ; Bullock in Kew Bull., **1952,** 421 (1952).

K. monroi S. Moore in Journ. Bot. **49,** 156 (1911).

Asclepias rivalis S. Moore in Journ. Bot. **52,** 337 (1914).

Spencer Moore described *Asclepias rivalis* from a specimen collected by *Gossweiler* (No. 5771) on the banks of the Lucalla River. I unfortunately overlooked the plant in my treatment of *Kanahia laniflora* in 1952, but since I had already included *Asclepias coarctata* S. Moore in its synonymy I paid little attention to the other species described by the same author.

Cynanchum *Linn.*

Cynanchum praecox *Schltr. ex S. Moore* in Journ. Bot. **40,** 256 (1902) ; N. E. Br. in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 399 (1903).

C. pygmaeum Schltr. in Engl. Bot. Jahrb. **51,** 140 (1913).

The wide geographical separation of the *loci classici* of the two plants here united—Southern Rhodesia and Northern Cameroons—no doubt influenced Schlechter in ascribing specific distinctness to the plant actually described by him ; the earlier name was given in a letter to Moore.

More recent collections, however, tend to eliminate the geographical difficulty and merely indicate that such an insignificant plant has been neglected by collectors.

My colleague, Mr. E. Milne-Redhead, who informs me that he overlooked *C. pygmaeum* (there is no specimen so named at Kew), recognised *C. praecox* among the plants he collected in Northern Nigeria and later among those collected by *Ford* in northwestern Tanganyika, and yet again among a set of duplicates of Congo plants presented to Kew from Brussels.

I found the plant twice, in northwestern and southwestern Tanganyika in 1950 and it is thus clearly a widely distributed, if never abundant, plant. The only record from the Rhodesias is the original gathering by *Rand*.

The following is a record of the collections of this plant known to me, in addition to the type gathering :—

Northern Nigeria. About 5 km. north of Zaria, in grassland, after burning, among bases of coarse grass ; " herb, probably with tuberous rootstock, stem leafless, very dwarf, 3–5 cms., flowers numerous, calyx dull purplish, rest of the flower cream " ; 15 Feb. 1941 (fl.), *Milne-Redhead* 5030 (with material in spirit).

French Cameroons. " Abgebrannte felsige Baumsavanne zwischen Tapare und Tukurua, 1250–1500 m.; Jan. 1909 (fl.), *Ledermann* 2152 ". " Gebranante felsige niederige Gebüschsavanne bei Banjo, ca. 1100 m.; Jan. 1909 (fl.), *Ledermann* 2226, 2230".

Fig. 6. The known distribution of *Cynanchum praecox* Schlecht.

Belgian Congo. Parc National Garamba, savane arborescente ; " fleurs jaunes " ; 3 Feb. 1950 (fl.), *de Saeger* 106 G (*herb. Kew et herb. Brux.*)

Tanganyika Territory. Bugene, Bukoba District, 5000 ft., on recently burnt ground, exposed hill-top ; " small plant forming low cushions 2–3 ins. diam., flowers white ; " 21 July 1947 (fl.), *Ford* 190 (*herb. Afr. Or. Nairob., icon. del.* P. Taylor *in herb. Kew.*). Kibondo, in very hard stony ground at base of severely burnt rounded hill ; " long, tough rootstock, flowers olive-green with white corona "; 7 Aug. 1950 (fl., very young fr.), *Bullock* 3096. Mbisi, Ufipa Plateau, 7500 ft., in rock crevices on eroded, fire-swept hillside ; " plant brownish olive-green, flowers pure white "; 6 Oct. 1950 (fl.), *Bullock* 3419.

Southern Rhodesia. Valley of the Mazoe River, Salisbury district ; Sept. (fl.), *Rand* 512 (*holotypus in herb. Mus. Brit., dupl. in herb. Kew.*).

Mr. Milne-Redhead's suggestion that the plant has a tuberous root-stock is very possibly true ; in my endeavour to dig up the whole plant at

Kibondo I was only able to dig to about six inches below the surface owing to the excessive hardness of the ground, whilst on the Ufipa it would have been necessary to blow the rocks apart in order to obtain the rootstock.

Cynanchum validum *N. E. Br.* in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 398 (1903) ; Hutch. et Bruce in Kew Bull. **1941,** 145 (1941).

Schizostephanus alatus Hochst. ex K. Schum. in Engl. Bot. Jahrb. **17,** 139, t. 6 N–Q (1893), et in Engl. Pflanzenw. Ost Afr. **C,** 324 (1895), non *Cynanchum alatum* Wight et Arn. (1834).

Brown (1903) gave Abyssinia, Eritrea and Tanganyika for the distribution of this species. Specimens now preserved at Kew greatly extend this range and also fill in some of the greater gaps. In the north, it has been collected by *Gillett* (No. 4863) at Jifa Meidir, in British Somaliland ; by *Maitland* (No. 651) near Kampala in Uganda ; by *Bally* (No. 1946) at the Nzue River, Northern Frontier District, and by *Kässner* (No. 680) at the Kibwezi River in Kenya Colony. From Tanganyika there are two specimens, *Koritschoner* 1677, 1710, collected in the Shinyanga district.

In addition to the specimens listed above, I have now identified the following :—

Southern Rhodesia. Marandellas District, on trees by cave on granite whaleback ; " high climber, winged follicles ; " April 1950 (young fr.), *Wild* 3262 (Govt. Herb. Salisbury No. 27365).

Cynanchum somaliense (*N. E. Br.*) *N. E. Br.* in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 398 (1903) ; Chiov. Fl. Somala, **2,** 296 (1932) ; Hutch. et Bruce in Kew Bull. **1941,** 145 (1941).

Schizostephanus somaliensis N. E. Br. in Kew Bull. **1895,** 250 (1895) ; K. Schum. in Ann. Istit. Bot. Roma, **7,** 38 (1897).

The following is a further new record for Kenya :—

Kenya Colony. El Wak, Northern Province, 2° 49′ N., 40° 56′ E., 360 m., a twiner in a clump of bushes in a small swallet hole ; May 1952 (fl., fr.), *Gillett* 13340.

The follicles, not hitherto described, are rather broadly fusiform, glabrous, sparsely softly echinate, about 6 cm. long, rather less than 2 cm. diam. at the widest part and narrowed to a subacute apex.

With *C. validum* this species forms a very distinct group within the genus *Cynanchum*, characterised by a pedunculate racemiform inflorescence.

Cynanchum hastifolium *N. E. Br.* in Kew Bull. **1895,** 257 (1895), et in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 397 (1903) ; K. Schum. in Engl. et Prantl, Naturl. Pflanzenfam. **4** (2), 253 (1895) ; Chiov. Fl. Somala, **2,** 295, f. 171 (1932) ; Hutch. et Bruce in Kew Bull. **1941,** 145 (1941).

This species has been recorded hitherto only from Somaliland and Eritrea. The following specimens indicate that it occurs throughout the drier areas of eastern Kenya and in the similar country of north western Tanganyika :—

Kenya Colony. Northern Province : Dandu, 2500 ft. on both black cotton and red loam soil ; " twiner, corolla green, corona white " ; April 1952 (fl.), *Gillett* 12747 : Furroli, 3200 ft., lava plain ; " twiner, calyx and corolla green, corona white (flowers in

spirit) ; " Sept. 1952 (fl., fr.), *Gillett* 13863. Ithaba, 3000 ft., in orchard country ; " climber " ; May 1938 (fl.), *Bally* 8357. Kibwezi, 3000 ft.; April 1938 (sterile), *Bally* 7923. Garabani Hill, 4900 ft.; July 1940 (young fl.), *van Someren* 293.

Tanganyika Territory. Shinyanga ; *Koritschoner* 2084.

Mr. Gillett found only one plant at Furroli, but his specimen is ample in quantity and excellent in quality. Fruit was hitherto unknown and although the follicles are dehisced and without seed it can be seen that before dehiscence they are very narrowly fusiform, some 10 cm. long and about 1·5 cm. diam. at the widest part near the base, and gradually tapered to a very acute apex. They are quite smooth, unwinged and glabrous.

In the type and other material from Somaliland, all the ten main teeth of the corona are about equal in length, though five are deltoid and five filiform or linear. The southerly extension of the range shows increasing length of the filiform teeth, which in the Shinyanga specimen are more than twice as long as the deltoid ones.

There is a close relationship between this species and *C. clavidens* N. E. Br., originally collected in Somaliland by *James and Thrupp* about 1885, and recorded for Italian Somaliland by Chiovenda (Res. Sc. Miss. Stefanini-Paoli Somal. Ital. **1,** Coll. Bot. 116 : 1913). *C. clavidens* differs from *C. hastifolium* in its shorter corona and relatively long exserted style ; it is otherwise barely distinguishable in the herbarium, and I am inclined to doubt its specific distinctness.

Tenaris *E. Mey.*

Tenaris rubella *E. Mey.* Comm. Pl. Afr. Austr. 198 (1837), typus nominis generici ; Decne. in DC. Prodr. **8,** 606 (1844) ; Harv. Gen. S. Afr. Pl. 223 (1838), et Thes. Cap. **1,** 28, t. 43 (1859) ; Schltr. in Engl. Bot. Jahrb. **18,** Beibl. No. 45, 12 (1894), et *l.c.* **20,** Beibl. No. 51, 45 (1895), et *l.c.* **21,** Beibl. No. 54, 12 (1896), et in Journ. Bot. **35,** 291 (1897) ; N. E. Br. in Thiselton-Dyer, Fl. Cap. **4** (1), 795 (1908).

T. rostrata N. E. Br. in Gard. Chron. Ser. 2, **24,** 39 (1885), et in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 473 (1903) ; Schltr. in Journ. Bot. **33,** 339 (1895) ; K. Schum. in Engl. Pflanzenw. Ost Afr. **C,** 327 (1895).

T. volkensii K. Schum. *l.c.* et in Engl. et Prantl, Naturl. Pflanzenfam. **4** (2), 295, f. 91 (1895).

T. simulans N. E. Br. in Thiselton-Dyer, Fl. Cap. **4** (1), 796 (1908).

I have been quite unable to find satisfactory characters to separate Brown's *T. rostrata* and *T. simulans* from the original *T. rubella* E. Mey. and have therefore united them with it. *T. volkensii* K. Schum. was reduced by Brown himself. The geographical distribution of the species is now considerably extended compared with the records in the *Flora of Tropical Africa* and the *Flora Capensis*.

There are specimens at Kew from Natal, connecting the Transvaal collections with those from the eastern Cape Province, whilst in east tropical Africa there are several further collections from Tanganyika extending the range westwards to the Bukoba district, from Ruvuma Island and the Ankole district of Uganda and from Chyulu North and Garabani Hill in Kenya.

DICHAELIA *Harv.*

N. E. Brown (1908) reduced *Dichaelia* Harv. to *Brachystelma* R. Br. a genus which by sundry additions since it was established by R. Brown in 1809 has become very heterogeneous. I propose, therefore, to resuscitate *Dichaelia* Harv. and to include in it all those African species in which the tips of the corolla-lobes are connate. The genus was maintained by Bentham (1876) in the *Genera Plantarum*, by Schlechter (1895 et seq.) and by K. Schumann (1895) in the *Pflanzenfamilien*. Schlechter gave reasons for maintaining the genus in Engl. Bot. Jahrb. **51,** 145 (1913).

The type of the generic name is *Dichaelia filiformis* (Harv.) Schltr., for although Harvey based the genus on his own *Brachystelma filiforme*, he never made the necessary new combination.

Dichaelia circinata (*E. Mey.*) *Schltr.* in Engl. Bot. Jahrb. **21,** Beibl. No. 54, 13 (1896) et in Journ. Bot. **35,** 294 (1897).

Brachystelma circinatum E. Mey. Comm. Pl. Afr. Austr. 196 (1837) ; N. E. Br. in Thiselton-Dyer, Fl. Cap. **4** (1), 858 (1908).

B. commixtum N. E. Br. *l.c.*

N. E. Brown separated the two parts of *Drége* 3440 on account of the greater amount of indumentum on one of them, which he designated as the type of Meyer's species. Apart from the indumentum difference, I find little to separate the two plants which cannot be attributed to normal variation between individuals.

Dichaelia galpinii *Schltr.* in Engl. Bot. Jahrb. **18,** Beibl. No. 45, 25 (1894), et in Journ. Bot. **35,** 293 (1897).

D. pallida Schltr. in Engl. Bot. Jahrb. **20,** Beibl. No. 51, 49 (1895), et in Journ. Bot. **35,** 294 (1897).

D. microphylla S. Moore in Journ. Bot. **41,** 312 (1903).

Brachystelma galpinii (Schltr.) N. E. Br. in Thiselton-Dyer, Fl. Cap. **4** (1), 860 (1908) ; E. P. Phillips in Fl. Pl. S. Afr. t. 536 (1934).

B. pallida (Schltr.) N. E. Br. *l.c.* 861.

Brown (1908) separated the two plants here united by means of the more pubescent leaves and stems of *D. pallida*, but in his text he stated that he was doubtful as to their specific distinctness. Later (*MS. in herb. Kew.*) he annotated all gatherings of both as being conspecific.

Dichaelia elongata *Schltr.* in Engl. Bot. Jahrb. **18,** Beibl. No. 45, 35 (1894), et in Journ. Bot. **35,** 293 (1897).

Brachystelma elongatum (Schltr.) N. E. Br. in Thiselton-Dyer, Fl. Cap. **4** (1), 862 (1908).

B. distinctum N. E. Br. *l.c.*

Brown described *B. distinctum* without having seen *D. elongata*, and later annotated the Kew specimens as being conspecific with the latter.

Dichaelia gracillima (*R. A. Dyer*) *Bullock*, comb. nov.

Brachystelma gracillimum R. A. Dyer in Journ. S. Afr. Bot. **11,** 112, f. 6 (1945).

Dichaelia pygmaea *Schltr.* in Journ. Bot. **32,** 262 (1894), et *l.c.* **35,** 293 (1897).

D. breviflora Schltr. in Engl. Bot. Jahrb. **20,** Beibl. No. 51, 49 (1895) et in Journ. Bot. **35,** 294 (1897).

Brachystelma pygmaeum (Schltr.) N. E. Br. in Thiselton-Dyer, Fl. Cap. **4** (1) 857 (1908), incl. var. *breviflorum* N. E. Br. *l.c.* ; Dyer et Bruce in Fl. Pl. Afr. t. 1088 (1950).

The following is, apparently, a new record for Southern Rhodesia : —

Southern Rhodesia. Inyanga, at the summit of Mt. Inyangani, 8400 ft., in rock fissures and amomg rocks, in moss; Oct. 1946 fl.), *Sturgeon* (S.R. Govt. Herb. No. 16950) *s.n. in herb. Kew.*

Dichaelia hirtella (*H. Weim.*) *Bullock*, comb. nov.

Brachystelma hirtellum H. Weim. in Botan. Notis. **1935** (No. 22), 406, ff. 20 a–d, 21 (1935).

Dichaelia barberae (*Harv. ex Hook. f.*) *Bullock*, comb. nov.

Brachystelma barberae Harv. ex Hook. f. in Bot. Mag. t. 5607 (1866) ; Schltr. in Engl. Bot. Jahrb. **18,** Beibl. No. 45, 25 (1894), et in Journ. Bot. **35,** 292 (1897) ; N. E. Br. in Thiselton-Dyer, Fl. Cap. **4** (1), 864 (1908), E. P. Phillips in Fl. Pl. S. Afr. t. 354 (1929).

Tylophora *R. Br.*

Tylophora conspicua *N. E. Br.* in Kew Bull. **1895,** 258 (1895), et in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 405 (1903) ; Hiern in Cat. Afr. Pl. Welw. **1,** 691 (1898) ; Norman in Journ. Bot. **67,** Suppl. 2, 96 (1929) ; Hutch. et J. M. Dalz. Fl. W. Trop. Afr. **2,** 59 (1931).

T. migoje Schltr. MS. in herb. Stolz.

N. E. Brown (1903), recorded this species from Angola and the Gold Coast. Norman (1929) recorded it from Uganda, and Hutchinson and Dalziel (1931) from the Ivory Coast. It is now known also from Liberia (*Harley* 1203), the Belgian Congo (*Louis* 15811) and from the French Cameroons (*Zenker* 3780), whilst its eastern distribution is extended to Tanganyika. The following east African specimens are at Kew :—

Uganda. Entebbe, 3900 ft., in a portion of natural forest in the Botanic Garden; Oct. 1935 (fl.), *Chandler* 1434.

Tanganyika Territory. Amani ; Nov. 1922 (fl.), *Soleman* 6221. Near Kimboza, on the Mikese Kisaki Road, Morogoro District, 1300 ft., " climbing perennial plant with purple flowers growing over bushes and small trees in rain-swamp forest in black soil on limestone formation, not common "; Sept. 1930 (fl.), *Greenway* 2521. Kyimbila District, 1800 m. ; March 1912 (fl.), *Stolz* 1165.

Solenostemma *Hayne*

Solenostemma oleifolium (*Nectoux*) *Bullock et Bruce* in herb. Kew., comb. nov.

Cynanchum oleaefolium Nectoux, Voy. Egypte, 20, t. 3 (1808).

Solenostemma argel Hayne, Arzneyk. Gewachse, **9,** t. 38 (1825) ; Decne. in DC. Prodr. **8,** 533 (1844) ; N. E. Br. in Thiselton-Dyer, Fl. Trop. Afr.

4 (1), 403 (1903), cum syn. ; Muschler, Man. Fl. Egypt, **2,** 749 (1912) ; Diels in Engl. Bot. Jahrb. **54,** Beibl. No. 120, 109 (1917) ; Turrill in Kew Bull. **1923,** 239 (1923) ; Hutch. et J. M. Dalz. Fl. W. Trop. Afr. **2,** 56 (1931) ; J. M. Dalz. Useful Pl. W. Trop. Afr. 390 (1937) ; Corti, Fl. e Veg. del Fezzan e della Reg. di Gat, 207 (1942).

There is no doubt of the validity of Nectoux's epithet for this species ; he discusses the plant at some length and his coloured plate is sufficient for identification.

Brown recorded the plant from the Sudan, Egypt and Arabia ; there is now also at Kew additional material from the central Sahara (13 miles south-west of Abelessa, March 1930, *Chipp* 68 ; Arak, Feb. 1931, *Meinhertzhagen* 165), from which area it was recorded by Turrill (1923). It is, apparently, widely though sparsely distributed in the Sahara.

Curroria *Planch. ex Benth.*

The resuscitation of the genus *Curroria* Planch. ex Benth. (in Hook. Nig. Fl. 457 : 1849), and the addition of plants from a far distant area to it, calls for some comment.

Curroria was based on a plant collected in southern Angola by Curror which is now known from the Mossamedes district and southwards to the border of South West Africa and South Africa in Little Namaqualand. It differs from *Cryptolepis*, in which it has been included, in certain details of floral structure, but more strikingly in habit. N. E. Brown at once separated it in his key to the species of *Cryptolepis* (*Flora of Tropical Africa*, 1902) by means of its short flowering shoots (spurs) :—

" Leaves of short lateral flowering shoots crowded, subfasciculate, linear-spathulate ; flowers solitary . . . . . 1. *C. decidua*

Leaves all opposite or in whorls of 3, rarely alternate, pairs or whorls distant ; flowers in 2 to many-flowered cymes or panicles . . . . . ."

The second group contains species of the genus *Ectadiopsis* Benth. which I propose also to resuscitate : these are virgate shrubs with either whorled or opposite leaves. Occasional solitary (alternate) leaves may occur, in this and other groups of genera, usually towards the base of particularly vigorous shoots.

In *Curroria* the long shoots have distant, strictly opposite leaves and there may be occasionally a three-flowered cyme in their axils. The tips of the long shoots may become spirally coiled but they are not primarily climbing ; the plants are erect intricately branched shrubs. The pseudo-climbing habit is not uncommon in this family and in the *Apocynaceae* and I have earlier (Kew Bull. **1952,** 424 and *l.c.* **1953,** 64) drawn attention to cases where it may become functional.

I have reduced *Cryptolepis volubilis* (Balf. f.) Schwartz and *C. gillettii* Hutch. et Bruce to subspecies subordinate to *Curroria decidua**, the differences between the three forms being insufficient, in my opinion, to justify segregation which, at the same time, tends to obscure their very close affinity.

*Bentham (in Benth. et Hook. f., Gen. Pl. **2,** 741 : 1876) stated " *Species* 2 *Africae australis subtropicae incolae* " ; I have not been able to identify his second species.—A.A.B.

Good (New Phytol. **51,** 198—209 : 1952) has discussed at some length the distribution of the *Asclepiadaceae* and he remarks that the distribution of the *Periplocoideae*, compared with that of the *Gynanchoideae*, is related to the less specialized pollen mechanisms and therefore more ancient origin of the former subfamily. In the case of *Curroria*, with a distribution in the southwestern and northeastern desert areas of Africa, with outlying stations in the Hadramaut and Socotra, one may assume that the present representatives are relicts, the main population having been exterminated during the last or earlier pluvial epoch.

Curroria decidua *Planch. ex Benth.* in Hook. Nig. Fl. 457 (1849) ; Engl. in Engl. Bot. Jahrb. **10,** 244 (1888) et *l.c.* **19,** 148 (1894) ; K. Schum. in Engl. at Prantl, Naturl. Pflanzenfam. **4** (2), 219 (1895) ; typus nominis generici.

Cryptolepis decidua (Planch. ex Benth.) N. E. Br. in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 243 (1902).

In accordance with the views expressed above, I propose to divide this species into three subspecies, related to the geographical distribution :—

1. **C. decidua** subsp. **decidua.**

This includes the type element only and the subspecies occurs in the Mossamedes district of southwestern Angola and in Namaqualand southwards to or a little beyond the South West Africa-South Africa border. N. E. Brown (1902) saw only the type specimen which was collected by *Curror* in Angola, but there are now at Kew several gatherings by *Pearson* in South West Africa and Angola and one by *Gossiveiler* (No. 10954) at Chipia in the Mossamedes district of Angola. The flowers are stated by Pearson to be white, pink or mauve.

2. **C. decidua** subsp. **volubilis** (*Balf. f.*) *Bullock*, stat. nov.

Ectadiopsis volubilis Balf. f. in Proc. Roy. Soc. Edinb. **12,** 78 (1883), et in Trans. Roy. Soc. Edinb. **31,** 163, t. 47 (1888).

Cryptolepis volubilis (Balf. f.) Schwartz in Mitt. Inst. Bot. Hamburg, **10** (Festschr.), 187 (1939), saltem quoad syn.

This differs from the type in its shorter, stouter, more woody follicles, and in its tendency to produce more broadly spathulate leaves. Until Schwarz (1939) recorded it from Hadramant, it was thought to be confined to the island of Socotra. I have seen only the specimens cited by Balfour (1888) in his classic " Botany of Socotra ".

3. **C. decidua** subsp. **gillettii** (*Hutch. et Bruce*) *Bullock*, stat. nov.

Cryptolepis gillettii Hutch. et Bruce in Kew Bull. **1941,** 144 (1941).

This differs from the type in its slightly puberulous or scabridulous leaves, somewhat shorter corona-lobes and greenish-yellow flowers. Its follicles are more like those of the type than of subsp. *volubilis*. It is known only from Mr. Gillett's collection (No. 4773) at Dubar in British Somaliland.

Curroria migiurtina (*Chiov.*) *Bullock*, comb. nov.

Cryptolepis migiurtina Chiov. Fl. Somala, 217, t. 23, f. 4 (1929).

I have not seen the type of this species, but Chiovenda's description and

figure leave no doubt that the identification *ex descriptione* of the following specimens, by Miss Bruce many years ago, is correct :—

British Somaliland. Karin, 10° 57′ N., 49° 24′ E., 1100 ft., on a rocky ledge of an exposed hillside ; Oct. 1929 (fl.), *Collenette* 198. Einad, Al Hills, 11° 02′ N., 48° 55′ E., 2000 ft., on rocky hillside with other shrubs, in partial shade, fairly common ; Nov. 1929 (fr.), *Collenette* 316.

Mr. Collenette describes the plant as a shrub 2½–5 ft. high, with sticky latex ; the flowers are cream with a faint sweet scent.

C. migiurtina is readily distinguished from *C. decidua* by its broadly spathulate or obovate leaves. The follicles are very like those of *C. decidua* and Mr. Collenette obtained the Warsengeleh vernacular name " Geysa riad " which means " goat-horn ". Chiovenda recorded the plant only from the *locus classicus* in Somalia.

Secamone *R. Br.*

Secamone africana (*Oliv.*) *Bullock*, comb. nov.

Toxocarpus africanus Oliv. in Trans. Linn. Soc. **29,** 109, t. 108A. (1875).

Secamone platystigma K. Schum. in Engl. Bot. Jahrb. **17,** 143 (1893) ; et in Engl. et Prantl. Naturl. Pflanzenfam. **4** (2), 262, f. 76 K–L (1895) ; Hiern in Cat. Afr. Pl. Welw. **1,** 681 (1898) ; N. E. Br. in Thiselton-Dyer, Fl. Trop. Afr. **4** (1), 280 (1902).

The type of Schumann's species is a specimen from Angola collected by either *Mechow* or *Welwitsch* ;—he cited several specimens under the original description, without indicating a holotype, but they are all conspecific. The type of Oliver's species is a *Speke and Grant* specimen from Uganda.

The Angolan plant has been twice collected by Gossweiler (Nos. 712, 4878), but these are the only additions at Kew to the material from that area since Brown's enumeration in 1902. The east African plant has been collected many times and the material is amply sufficient to establish Brown's synonymy. It is apparently common in Uganda forests and has been twice collected in Kenya (*Bally* 6475 ; *Napier* 5234). It was collected as long ago as 1902 by *Chevalier* (No. 5492) in the Oubangui territory, and more recently *Lebrun* (Nos. 3425, 4634) has collected it in the Rutshura and Beni districts of the Belgian Congo.

All collectors are agreed that the species is a forest climber and Mr. H. C. Dawkins has provided the following notes with his specimen No. 610 collected in July 1950 :—

" About 10 miles southwest of Kampala, on the south-facing hillside in Nganjo mails immediately above milepost 13 on the old Entebbe road. Steep slope, very shallow soil over quartzite and consisting mostly of gravel from it, general colour pale reddish.

" Closed evergreen thicket bordering on heavily grazed very poor grass patch ; consisting of occasional trees of *Garcinia, Ekebergia, Pittosporum, Antiaris, Vitex fischeri, Antidesma venosum*, with dense mass of shrubs including *Dovyalis macrocalyx, Capparis erythrocarpa, Clausena, Gymnosporia, Chaetacme* and many climbers including *Paullinia, Landolphia, Rhoicissus* ; subject to weak side-scorching by fire.

" Common throughout this association and apparently at greatest development a high-forest liane.

" Climber reaching 3 m. high on shrub thicket. Flowers in conspicuous masses, creamy white, sweet scented. Old stem (3 cm. diam.) very roughly corky fissured, slash yellowish-brown, mottled, exuding copious sticky white latex. (Leaves when torn have latex-threads between the broken edges.")

There is only one specimen at Kew with fruit ; this is *Chandler* 330 from Serere. The follicles are more or less horizontally opposed, 9–10 cm. long, 7–9 mm. diam. near the base and gradually tapered to an acute apex.

WATERLILIES AS FOOD.

F. R. Irvine and R. S. Trickett.

Waterlilies are widely distributed throughout the world, especially in the Northern Hemisphere, and appear to have attracted the attention of mankind in many different countries from the earliest times. The numerous references to them in classical literature are evidence of the early interest they aroused in Mediterranean countries e.g. in Egypt and North Africa. Waterlilies may be valued today mainly on account of their great decorative qualities and the fact that they may be grown in ponds or other aquatic habitats where few other ornamental plants will grow. To early man however, often struggling hard to maintain a bodily existence, the value of waterlilies as food may have been of much more importance. Among the more primitive peoples of the Earth this may still apply for waterlilies are still used as food in many countries. In some countries they have proved of great value in times of famine. As little has been recorded in the general or the more recent literature on waterlilies with regard to their food qualities it is thought that the information that has now been collected may be worth recording.

It would seem probable (5) that waterlilies or *Nymphaea* " roots " are eaten in greater quantity in Africa than they are elsewhere and that local species are sometimes cultivated for food by African races.

An alkaloid (*nupharin*) is known to occur in the rhizome, and in other parts of the plant, of some species of *Nymphaea*, causing them to be somewhat poisonous or to require special treatment before being eaten. This applies to the common European species *Nymphaea alba*. Margherita Pizzetti (19) found the alkaloid in all parts of this species except the seed. In the vegetative parts the amount changed with the seasons. It may be the same or a similar alkaloid that makes some of the other species of *Nymphaea* unsatisfactory as food plants.

In general the tropical species of *Nymphaea* possess a short thick erect rootstock at the base of which are formed tubers, usually about the size of a medium sized potato. The temperate species on the other hand usually develop a horizontal rhizome which decays in its older parts as it elongates by apical growth.

RHIZOMES AND TUBERS

*Nymphaea lotus** Linn.—(=*Nymphaea* or *νυμφαία*).

Nymphaea lotus (Linn.) Willd. is a native of Africa, but it has been introduced into Asia where it has been cultivated probably from ancient times and is now widespread (5).

The tubers of *N. lotus* Linn. are often eaten on the Plains of India (and used also as a cooling medicine and demulcent) (1. p. 629). Burkill (5) and Watt also mention their use as food (28 p. 318) and Shortt quotes their use in India as a famine food (23) while other authorities agree that they are also an emergency food in other parts of the

*The Lotus eaters of the ancient world—Lotophagi and their neighbours, the Machyles, tribes of N. Africa, ate the "Forgetful Lotus" (*Zizyphus* sp.). Two species in the Leguminous genus *Lotus* were probably other kinds of 'Lotus'.

world (26, 27). When they grow in swamps they are often difficult to harvest. They are also eaten in the Philippines (5). In both India and China they are cooked.

Dalziel (11. p. 13) states that the use of the rhizomes of this species (and of other spp.) as food is probably world-wide. Dioscorides (12) is almost certainly referring to *N. lotus* Linn. when he states that the rhizomes ' like a quince ', are eaten both raw and cooked, the cooked roots resembling the yolk of an egg. Herodotus (Bk. 2. par. 92) also states that the roots are fit for food, are tolerably sweet and of the size of an apple. In India they are pounded and made into a kind of bread (18). They were also used for fattening hogs in the ancient world (9). The Budduma tribe of Lake Chad use the rhizomes (and seeds) as food, and other African tribes also rely on them for this purpose, eating them either raw or cooked. In Upper Guinea they are mainly used as an emergency (famine) food, and are roasted in ashes, or dried and ground to flour. The " roots " of a white-flowered species, "laze-laze" (probably those of *N. lotus* Linn. are used as food in Madagascar (15) and are considered, along with those of *N. capensis* Thunb. var. *madagascariensis*, to be delicious. The use of both these species as food in Madagascar is also quoted by Conard (9). The plant referred to as " talifouc " by Flacourt (15) as having edible tubers and described as a yellow-flowered *Nuphar* (a genus which does not occur in Madagascar) undoubtedly refers to one or more of the above species.

The starchy tubers of *N. lotus* Linn. (see p. 2) (and *N. caerulea* Savigny) (p. 4) are eaten in the dry season, when they consist of almost solid starch. They are eaten in parts of West Africa, either boiled, or roasted like potatoes (9).

The ancient Egyptians also used them as food and found them to be tolerably sweet (9). The method of cooking the rhizomes is generally by boiling or roasting.

Nymphaea stellata Willd.

The rhizome of *N. stellata* Willd, is pyriform and about the size of an egg. It is often eaten in India (1. p. 629) and also used as a famine food (28. p. 318). In Cochin China, Annam and Tonkin the rhizomes are eaten after roasting in hot embers (10) and the root tubercles are actually marketed in Tonkin. The rhizomes of *N. stellata* Willd. are used as food (and medicine) in Ceylon where they are called " Manel ", and keep fresh for a long time. They are short, erect, and enclosed in a thin covering which turns horny on drying. The covering is itself covered with a cottony substance, especially at the apex. The rhizome is full of starch and is very palatable when boiled or prepared with curry, being said to be more palatable than the Yam (*Dioscorea*) and Cocoyam (*Colocasia*). As the rhizomes have been sold in times past almost entirely as medicine, their cost as food has been prohibitive. They can be kept fresh for quite a long time. With the ' Grow More Food ' campaign in parts of Ceylon, some villages have taken up the cultivation of *N. stellata* Willd. in portions of paddy fields left uncultivated during the S.W. Monsoon (Yala season). ' Seed ' roots are first selected, then air dried and stored, and finally propagated in shallow mud and later transplanted to positions in rows 3 feet apart by 2–3 feet apart in the rows.

The mud is first prepared and manured with old weeds or stubble, or special compost. 2 cwt. of ' seed ' produces an average crop of 20 cwt. of rhizomes suitable as food (24). The roots are also eaten in Africa, though they are poisonous unless boiled (25). This information probably also applies to *N. caerulea* Savigny (5).

Nymphaea caerulea Savigny.

The starchy rhizomes of the blue diurnal flowered *N. caerulea* Savigny and *N. lotus* Linn. are collected in the dry season in West Africa, when they consist of almost solid starch, and are then boiled or roasted and eaten.

Nymphaea capensis Thunb.

The ' roots ' of a blue water lily, known in Madagascar as "Tantamon", probably *N. capensis* Thunb. var. *madagascariensis*, are used as food in Madagascar, and like those of *N. lotus* Linn. are considered to be delicious (15).

Nymphaea alba Linn.

The Polish poet Stowacki tells in his tragedy 'Lilla Weneda ' that in a time of famine in Poland, the rhizomes of a water lily (*N. alba* Linn.) were eaten. He tells about the ancient origin of the Polish people and how the daughters of an imprisoned Polish king (being starved by his enemies) brought to their father the rhizomes of *Nymphaea*, and so kept him alive. According to Margherita Pizzetti (19) however, an alkaloid (*nupharin*) occurs in all parts of this plant except the seed, though the amount changes with the seasons.

Nymphaea gigantea Hook.

In Australia both whites and aborigines used the tubers of the Giant Waterlily—*N. gigantea* Hook, as food, cooking them in the hot embers of the fire. When cooked in water they tend to turn bluish. The aborigines of North Queensland are also said to roast and eat them (17 p. 101). In other parts of Tropical Australia the aborigines roast the tubers in ashes before eating them (2 p. 151), and (13 p. 176) (wrongly attributed to *N. stellata* Willd. which does not occur in Australia). The rhizomes are also reported as being roasted and eaten by the aborigines by Maiden (16) and by Roth (22 p. 14) (wrongly attributed to *N. caerulea* Savigny).

Nymphaea spp.

The tubers of various Waterlilies (*Nymphaea* spp.) are gathered from the swamps in North Busoga (Uganda) and are an important foodstuff, especially in times of famine (27 p. 493).

Nelumbo nucifera Gaertn. (" Nelumbo " or " *κιβώριον* ".).

The spongy rhizomes (up to 3 feet long) of the Sacred Lotus *Nelumbo nucifera* Gaertn.) is eaten in the Plains of India (1 p. 630), while Watt (28 p. 318) quotes it as having been used as food during the Deccan famine. In North Queensland, the rhizomes are eaten (16), and the seeds of this plant, known there as " Pink Water Lily ", are cracked and eaten raw by the aborigines (17). Hooker (quoted by Maiden (16) states that the seeds are eaten raw or roasted as coffee in N. Australia.

Originally from S. Asia, this species was introduced long ago to Egypt, from whence it has now disappeared. It is the famous " Lotus of the Buddhists " and the Buddha, Brahma and other divinities are shown seated on a throne of Lotus i.e. a flower of the same plant.

Dioscorides (Book II) describes the Egyptian Nuphar (Nelumbo)—the root, like that of a cane, being eaten both raw and cooked (9). Herodotus (Bk. 2 par. 92) after speaking of the Egyptian lotus, which he considered to be a liliaceous plant, says ' there are likewise other lilies like roses, and these grow in the River Nile, whose fructification is produced in a separate seed vessel, springing like a sucker from the root, in appearance exactly resembling a wasp's nest, and containing a number of esculent seeds about the size of olive berries. These are also eaten, when tender and dry '.

Theophrastus (26) writes ' The root is thicker than the thickest reed, and cellular like the stem, and those who live about the marshes eat it as food either raw, or boiled or roasted'.

Nelumbo nucifera Gaertn. which the Chinese call " *Lin-ngau* ", and the Japanese call " *Hasu-no-ne* ", is one of the unique vegetables of the Orient, and is a productive aquatic crop which is in great demand (7). Large quantities of the rhizomes are shipped to the United States to supply the Oriental population there. In Hawaii the crop is harvested from July to November. Part of it is left ungathered to provide new plants in the following February (7).

For Soup. After any diseased parts of the rhizomes has been cut off the rhizomes are split length-wise, into $\frac{1}{2}$ inch lengths, which are then again washed. Slice thinly 1 lb. of lean pork and mix with 1 teaspoonful of corn-starch, 2 teaspoonfuls of soy sauce, and a little pepper. Boil in 1 quart of water and add 1 teaspoonful of salt, the pork mixture, and the lotus, and cook over a slow fire until tender. To serve with beef or pork. Prepare in the same way as directed for yard-long bean, but quarter the lotus lengthwise, slice thinly.

The white to buff-orange, sausage-like rootstock, 2–4 feet in length and $2\frac{1}{2}$–$3\frac{1}{2}$ inches in diameter is bought wholesale in China, boiled and sold in slices, or dried for future use, or transported elsewhere. The cross section shows 10 canals (See Figs. in 21). A kind of ' arrowroot ' is prepared from the fleshy rhizomes and is aromatic and sweet, and said not only to be nutritious, but tonic in its effects, and of medicinal value, including children's medicine. They are somewhat fibrous and therefore difficult to soften by boiling. They exude mucilaginous gum when freshly cut and contain 84·2% of water when fresh. The dried rhizomes have the following composition :—48·9% starch, 4·8% crude fibre, 4·8% ash. 2·1% cane sugar, 1·1% fat, and 14·2% of undetermined substances. There is vitamin C in both rhizomes and seeds. According to Blasdale (3) both the fresh rhizome and the dried sliced rhizome are sold in Chinese quarters of American cities. The fresh rhizome is eaten boiled and raw, and starch is also prepared from it.

Nelumbo lutea Persoon is a yellow-flowered water plant from the Antilles and the Southern United States. Its rhizomes and seeds (see p. 11) are both edible (30).

Nuphar

Dioscorides described another Nymphaea—nymphona (νυμφώνα) and its flower nouphar (νοῦφαρ)—probably a species of *Nuphar* (9).

LEAVES AND FLOWER PEDUNCLES

The tender leaves and flower peduncles of *Nymphaea stellata* Willd. are used in curries in Ceylon (24).

The stalks of both leaves and flowers of a Water Lily (*Nymphaea gigantea* Hook.) are eaten in times of emergency by both white people and aborigines in Australia. Maiden (16) and others report that the aborigines eat the flower stalks when young. Sometimes the older (seeding) stalks are peeled and eaten either raw or roasted.

The leafbuds of *N. tetragona* Georgi are eaten in Japan, dressed with vinegar (9).

FRUITS AND SEEDS

Nymphaea lotus Linn.

The young fruits are sometimes eaten as a salad (5).

According to Herodotus (l.c.) in ancient times when the Nile " is full and has made the plains like a sea, great numbers of lilies, which the Egyptians called lotus, spring up in the water : these they gather and dry in the sun, then, having pounded the middle of the lotus, which resembles a poppy, they make bread of it and bake it ". *N. caerulea* Sav. was similarly used by the ancient Egyptians in this way (9).

The Egyptians used to gather the heads, laying them in heaps till they putrefied, when the seeds were washed out, dried and ground up (20).

Dioscorides (12) describes how the millet-like seed is dried, beaten and made into bread by Egyptians (9). According to Pliny (20) " There is not any bread in the world (by report) more wholesome and lighter than this so long as it is hot ; but, being once cold, it is harder of digestion and becommeth weightie and ponderous'. Pliny also states that ' the Egyptian bakers knead the flour made from the seeds with milk or water to make bread ".

The seeds of *N. lotus* Linn. and of *N. stellata* Willd. are both used in India as food in time of emergency (29 p. 318) (4, vol. 1, 18).

The seeds of *N. lotus* Linn. (and other species) are sometimes bitter and are abstracted from the fermented fruits e.g. in ancient Egypt, and in West Africa at the present time. They are sometimes dried and stored before use. At other times they are dried and ground to a meal, but they are usually roasted, boiled (4) or made into a sauce (11) p. 13. The Hausas of N. Nigeria use the seeds in their diet, or in medicine. The seed coat is easily removed as the kernels dry. The kernels are rich in starch, oil and protein, and so should form a nutritious food. Bois (4) states that their food value is almost equivalent to that of cereals.

In W. Africa today the base of the flower (receptacle) of *N. lotus* Linn. and other species, and also the many seeded fruits are both edible (11). Travellers describe how women and children return to villages

laden with ripening fruits which are then laid in heaps to decay, after which the seeds can be washed out, dried and stored.

Nymphaea gigantea Hook.

The Australian aborigines bake the seed-heads of *N. gigantea* Hook. (not *N. caerulea* Sav.) in ' ovens ' made of stones, covered with bark over which ashes and sand is placed. As the " pods " become soft, the seeds are removed and can then be eaten (with the husks). The husks can be removed after long baking. In North Queensland the kernels are rinsed several times after grinding before being used as food (22 p. 14). Maiden (16) also reports the use of the ' fruits ' (i.e. seeds) as food by the aborigines of various parts of Queensland.

Nymphaea caerulea Sav.

The fruits and seeds of *N. caerulea* Sav. were also baked and made into a kind of bread by the ancient Egyptians (9).

Nymphaea stellata Willd.

The seeds of *N. stellata* Willd. are quoted by Burkill (5) and by Watt as an emergency food in India (28 p. 318). They are also said to be often eaten on the Plains of India. The seeds are stated to be eaten also in Africa (25) though this information may refer to *N. caerulea* Sav. (5).

Nymphaea gigantea Hook.

The seeds of *N. gigantea* Hook. are eaten by Australian aborigines (9). Both fruits and seeds are said to make good eating. The aboriginal women in Australia first chew the seeds before giving them to their children, otherwise they become " bound " in the children's stomachs.

Nymphaea tetragona Georgi.

The seeds are eaten in Japan (9).

Nelumbo nucifera Gaertn.

The seeds of the Sacred Lotus (*N. nucifera* Gaertn.) are used as a heart stimulant (1) p. 630. The seeds from a fruit " like a wasp's nest " and " of the size of an olive stone " were eaten by the ancient Egyptians (9). Diodorus Siculus refers to *Nelumbo* and Dioscorides also states that the fruit of *Nelumbo* was eaten in the ancient world (Egypt) (9).

The seeds, after removal of their coats, are white and are eaten in China either raw, candied, roasted, boiled, or ground into flour. They are considered nourishing and highly beneficial in preserving bodily health and strength, in promoting circulation and strengthening virility. It is said " The more you eat, the more you want of them ". But the plumule, which is green, must be removed from the cotyledon because it is very bitter (See (21) figure on p. 283). There is a saying in Chinese —" As bitter as the plumule of the lotus seed " (21). The lotus is actively cultivated in both China and Japan for its seeds and rhizomes. It is grown on a large scale by planting in terraced fields in the same manner as rice is cultivated. It is propagated by seeds surrounded by a ball of mud which is then cast into the swamps. Fortune reported its cultivation as a profitable crop in terraces along both sides of the Canton River near Whampoa in China, over 100 years ago. The seeds have generally been reserved as a luxury for the rich in China.

According to Blasdale (3) the seed contains a percentage of nutritive material of higher quality than that of cereals, but inferior to that of legumes.

A. L. Winton (29) quotes the following analysis for *Nelumbo Nucifera* Gaertn. (*Nelumbium speciosum* Willd.) by Blasdale (3).

Composition of Seed parts per 100	*Large Seed*	*Small Seed*
Water	8·72	9·40
Protein	16·64	17·73
(N × 6·25)		
Amides	1·17	0·09
Fat	2·44	2·96
Starch	51·64	40·63
Sucrose	4·09	9·55
Reducing sugars	2·41	—
Other Carbohydrates ...	7·88	12·63
Fibre	3·15	2·95
Ash	3·03	4·15

Nelumbo lutea (Willd.) Pers. " American Lotus " or " Water Chinkapin ". (See fine habit figure in (30)). The Indians of N. America roasted the seeds. They even extracted oil from them by crushing, boiling and cooling, and then skimming off the oil. The seeds were also ground into meal for soups or " mush ".

Colville (8) writes " The Klamath Indians now live upon a reservation in the State of Oregon which lies within a somewhat larger area occupied by them long before their discovery by the white race . . . One of the plants growing abundantly in the marsh and less extensively in some of the bays of the lake (Klamath Marsh and Klamath Lake), the great yellow water lily *Nuphar Polysepala* Engelmann (=*Nymphaea polysepala* Kuntze) was a staple farinaceous food of the Klamaths in primitive times and now regarded by them as a delicacy. Klamath Marsh contains about 10,000 acres of a solid growth of Wokas. Spokwas is the name applied to the more mature and dissolving pods which contain larger, whiter and more palatable seeds. The women gather the seed-pods from a boat, working from about 8 o'clock in the morning until 6 p.m."

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400 Plants of South Florida.*—This is just one more book for the tourist, gardener and amateur plant-lover. It describes, often all too simply, in alphabetical order of Latin names, a large number of the better known trees, shrubs and vines of South Florida. Very many of the species included are cultivated garden plants which are natives of the Old World. Only a few herbaceous plants are mentioned. The family, common names, distribution and uses of each selected species are given, and there are 28 full-page pen-and-ink drawings. At the end we find a bibliography of " other publications on Florida plants ", which would have been more accurately headed " other similar publications ", since there is no reference to any of the scientific floras by J. K. Small. This book can help the amateur only if he already knows either the Latin or common name of a given species. It has no claim to notice in a scientific periodical, and one would hesitate to recommend it to a British tourist.

N.Y.S.

*400 Plants of South Florida, by Julia F. Morton and R. Bruce Ledin. pp. 134 ; frontispiece and 27 plates. Text House (Florida) Incorporated, 1952. Price $3.50.

NOTES ON ASIATIC GRASSES : XIII.

Corrugaria Hack. a subgenus of Isachaemum Linn.

N. L. Bor

In D.C., Monogr. Phan. **9,** 251 (1889) Hackel established a new subgenus of the genus *Ischaemum* Linn., which he called *Corrugaria* Hack. This subgenus was based upon one specimen, collected in India by Baron Charles von Hügel. Hackel christened his new species *Ischaemum hügelii* Hack. in honour of its discoverer.

Hackel defined the subgenus *Corrugaria* Hack. as follows—" Raceme solitary ; all spikelets awnless ; glume IV in the sessile spikelets 1-nerved, in the pedicelled nerveless ; pedicellate spikelets 2-flowered, with each floret male, or with rudimentary anthers ; joints of the raceme thickened, disarticulating by an oblique plane ; pedicels very short—a subgenus which connects the genus *Ischaemum* with the *Rottboellias* extremely closely and might, indeed, with almost equal justification, be included in either, but in habit and in the structure of the pedicel and spikelet (except for the entire fourth glume) so similar to *I. semisagittatum*, that I scarcely doubt that it derives its origin from some species of *Ischaemum* closely allied to that species (I. semisagittatum)."

Hooker f. in the *Flor. Brit. India* **7,** 139 (1896) lists *I. hügelii* Hackel among the doubtful species with an abridged translation of Hackel's diagnosis, and leaves it at that. He obviously did not see the type sheet.

Through the courtesy of the Director of the Vienna Herbarium, the type sheet was made available for inspection. It turns out to be a very poor specimen consisting of a single raceme of the *Ischaemum* and the basal portion of an entirely different grass which Mrs. Agnes Chase, on a slip, in 1922, conjectured to be a portion of an *Oplismenus*. The leaves of the latter are variegated yellow and green, and one would hazard a guess that the species represented is *Oplismenus burmanii*. (There is a specimen of this species at Kew, collected in Simla, which also has variegated leaves).

I. hügelii Hack. comes very close to, if it is not identical with *I. inerme* Stapf ex Bor. The difference between them is that *I. inerme* Stapf has the terminal racemes in pairs and the joints of the racemes are inflated and turbinate and not compressed as in *I. hügelii* Hack.

Now *I. inerme* was based on one of a number of sheets collected by R. C. Wroughton at Bandra in Bombay. Among these sheets is one in which the resemblance to *I. hügelii* Hack. is striking. This specimen has a single raceme, the joints are compressed and the hairiness of the lower glume and articulation in the upper portion of the racemes are similar to those in *I. hügelii*. On the other hand, it differs from it in that the folds in the lower part of the lower glume of the sessile spikelets are rounded and often incomplete and not angled and complete, as in *I. hügelii*. The internal structure of both is identical.

It may very well be that the type of *I. hügelii* is an abnormal form of *I. inerme* Stapf in which the turbinate joints have not been developed for some reason. If this should prove to be so, then *I. inerme* Stapf will become a synonym of *I. hügelii*.

I. hügelii Hack. has the aspect of a typical *Ischaemum* and agrees with the others in structure. It certainly looks very different from any member

of the *Rottboellinae* as at present understood, and there does not appear to be any justifiable reason for retaining the subgenus *Corrugaria* Hack.

Returning to the specimen itself and its provenance—the label on Hügel's specimen reads " Asia Busser no. 1658 ", without any further details. This locality is expanded in Hackel's account of the species in *D.C., Monogr. Phan.* **9,** 252 (1889), to " India orient. in civitate Busser (Bussahir)" and by Hook. f., *Flor. Brit. Ind.* **7,** 140 (1896) to " The Panjab, at Busahir ". The area designated by the various spellings Busser, Bussahir, Busahir, Bursahir (Brandis), Beshir (Thomson), all refer to the State of Bashahr, one of the Simla Hill States. Although one is apt to think that Hügel's main journeys in India were confined to the west coast, he actually did considerable exploration in the Himalaya. On his last journey he reached Calcutta from Madras in 1835, proceeded up the Ganges from that port to Banaras, and explored the plains of Northern India. He then penetrated into the Himalaya, crossing the Sutlej in September of the same year, and arrived in Kashmir, returning to Lahore at the end of the year. If the specimen under consideration was collected, as assumed, in Bashahr State, it must have been collected on that journey. From Lahore he proceeded through the Rajput States, Jaipur, Udaipur to Surat, and finally to Bombay. He sailed for Europe in 1836.

Despite the fact that the specimen was assumed by Hackel and Hooker to have been collected in the Punjab, there are good reasons for believing that this was not so.

The specimen, whether it is identical with *Ischaemum inerme* Stapf or not, is closely related to a group of *Ischaema* which is found at low levels in very hot climates, and which possesses no relative in the Himalaya, an area which, particularly in its western parts, is well known. In fact, nothing like it has ever been seen in the Western Himalaya, which is not strong in *Andropgoneae,* and, indeed, Stewart* does not list any species of *Ischaemum* from northwest India. While the occurence of *I. hügelii* in the State of Bashahr is not altogether ruled out, the strong probability is that the specimen was collected by Hügel in Bombay just before he sailed for Europe, and that his collections were labelled afterwards.

Bibliography on Southwestern Asia.†—This bibliography contains 3,016 selected titles covering an area ranging from Istanbul to the Hindu Kush on the north, from Aden to the Makran coast on the south and from the Suez Canal on the west to the eastern boundary of Afghanistan.

Following the Introduction the bibliography contains a list of abbreviations. It is then divided into (1) Anthropogeography, and (2) Natural History, the latter being again divided into Zoology and Botany, followed by the index.

This is a very useful source of reference for workers on this area.

H. S. MARSHALL.

*R. R. Stewart. Grasses of Northwest India, in Brittonia **5,** 404-468 (1945).

†Bibliography of Southwestern Asia. By Henry Field. Pp. xvi + 106. University of Miami Press, 1953. Price

NOTES ON CYPERACEAE : XXXI*.

E. Nelmes

The African Genus Coleochloa.

The genus *Coleochloa* was long known as *Eriospora* until there was found to be an earlier *Eriospora*, of Berkeley and Broome, a genus of fungi. This appears to have been first pointed out by Hutchinson[4] who rightly reduced *Eriospora* Hochst. ex A. Rich. to synonymy. His choice of *Catagyna* Beauv. ex Lestib. [5] to replace *Eriospora*, however, based on a suggestion of Bentham's,[1] was not a happy one because, as shown by Gilly, the description of *Catagyna* applies to some other genus. Gilly suggests that this may be *Scleria*, but the short original description leaves this identification very uncertain, and the location of the Du Petit Thouars specimen on which *Catagyna* is based is not now known. Gilly[3], therefore, in his account of this genus and its allied genera *Trilepis* and *Microdracoides* in the tribe *Lagenocarpeae* (*Cryptangiae*), rejected *Catagyna* and proposed *Coleochloa*, in allusion to the grass-like sheath.

It is not necessary to discuss here the relationship of *Coleochloa* to *Trilepis* and *Microdracoides*, nor the question of the correct placing of this group within—or without !—the *Cyperaceae*, as these matters have been discussed at considerable length by Gilly. The three genera are distinguished from one another by a number of very well-marked characters.

That *Coleochloa* is a most remarkable genus will readily be seen from the description of its species, including the key, given below. The compressed stem, distichous and deciduous leaves, the line of hairs in the position of the graminaceous ligule, and the sheaths open on the ventral side, have an almost exact counterpart in certain grasses, while the combination of utricle, free membranous pericarp, and caryopsis-like seed, lead one to question whether it and its allies are rightly placed in the *Cyperaceae*.

A special word is necessary concerning the fruit and seed because Gilly and others who studied the genus before him seem to have misunderstood the nature of these organs. The membranous, utriculate, outermost structure has by these botanical writers been termed a nut or achene, and the three stigmas protruding from the apex of its upper beak-like part considered to be continuous with it. This idea is clearly indicated in Miss M. Smith's[2] drawing of the similar utricle in the west African *Eriospora pilosa* (Boeck.) Benth., now placed by Gilly in the genus *Trilepis*. Even if this were so, the term " achene " would not seem to be appropriate for such a membranous structure, more or less loosely enveloping the seed. In fact, the stigmas are here considered to branch from the apex of an extremely slender style which is situated inside the beak of the utricle, expanding below into a thinly membranous, free pericarpial structure, which is not and does not become adnate to the seed to form the typical cyperaceous nut. The seed itself bears a striking resemblance to the grain or caryopsis of grasses.

The species of *Coleochloa* are extremely homogeneous in their non-vegetative characters ; the spikes, spikelets, glumes, utricles, and seeds being very similar indeed in shape and size, and usually in colour, through-

*Continued from K.B. 1952, 290 (1952).

out the genus. This constancy in facies extends, indeed, into the allied genus *Trilepis*, or at least to the African species, *T. pilosa* Boeck. It is reflected in the key to *Coleochloa*, where the genus is divided almost equally into two parts by quite a number of distinct vegetative (not floral) characters and modes of growth. This clear vegetative division is the more remarkable when one considers the similarity of habitats throughout the genus, usually cracks and crevices in granitic rocks and sandstone-quartzites on bare slopes and summits of mountains and high hills.

The following abbreviations are used for the herbaria from which I have seen and cited specimens : B, Berlin ; BM, British Museum (Natural History) ; BR, Brussels ; EA, East Africa Herbarium, Nairobi ; FI, Firenze ; K, Kew ; and PRE, Pretoria.

I wish here to express my indebtedness to several of my colleagues for help with this revision, and especially to Mr. C. E. Hubbard and Mr. B. de Winter.

Coleochloa *Gilly*.

Coleochloa *Gilly* in Brittonia, 5 : 12 (1943).

Eriospora Hochst. ex A. Rich., Tent. Fl. Abyss. 2 : 508 (1851), *non* Berkel. *et* Broome (1850).

Catagyna sensu Hutch. in Hutch. & Dalz., Fl. W. Trop. Afr. 2 : 490 (1936), *non* Beauv. ex Lestib. (1819).

Perennial herbs, either loosely tufted with few stems arising extravaginally or densely tufted with numerous stems arising intravaginally. *Stems* erect, compressed below, sometimes subcylindric, especially above, glabrous (except in *C. setifera*). *Leaves* rather numerous but not crowded in the lower part of the stem, which exceeds or is exceeded by them in length, distichous, blades equitant below, flat, conduplicate, or convolute-cylindric above, coriaceous, deciduous through the formation of an abscission zone at the junction with the *sheath*, which is persistent, open on the ventral side, and with a line of hairs representing a ligule ; *sheaths* long, completely covering the lower part of the stem. *Inflorescence* paniculate, in axillary and terminal, bracteate, peduncled fascicles of several to numerous pedicelled spikes, or these rarely (*C. virgata*) in sessile clusters. *Bracts* foliaceous, sheathing ; *sheaths* open in front. *Spikes* densely composed of several to rather numerous unisexual and bisexual spikelets. *Bracteoles* glumiform, amplexicaul or shortly sheathing at the base, aristate. *Spikelets* male or bisexual, composed of about 4–5 distichous *glumes*, of which the lower 2 are empty and smaller than the upper 2–3, which subtend male flowers, or 1–2 female and 1–2 male flowers, with sometimes deviations from these arrangements including an empty terminal glume. *Male flower* composed of 3 (1) *stamens* which are sessile at first, the filaments elongating later ; *anthers* mucronate at the apex. *Female flower* loosely surrounded by a trigonous, sac-like, membranous *utricle* from the apex of which the 3 *stigmas* are only just exserted, the *style* being situated in the upper beak-like portion of the utricle and merging below into a free membranous *pericarp* which is loosely situated between the utricle and the much smaller, slenderly subcylindric or compressed-trigonous *seed* situated at the base. *Perianthial*

membrane surrounding the base of the utricle apically reduced to fimbriated tufts of numerous erect, hair-like structures which are either fine, smooth, and unicellular, or stouter, minutely setulose, and multicellular.

Key to the Species.

1. Stems loosely tufted, developing from extravaginal shoots, 3–10 mm. broad (including leaf-sheaths) near the base, glabrous ; leaves flat to conduplicate, rarely convolute-cylindric, glabrous except sometimes the upper surface midrib, 2–9 mm. wide, often somewhat curved above ; hairs at the base of the utricle very slender, smooth, unicellular :
   2. Upper surface midrib of leaf glabrous ; glumes pale but often with reddish-brown patches :
      3. Leaves 4-6 mm. wide ; spikes mostly ellipsoid, 6–10 mm. long ; utricles 4·5–5·25 mm. long . . . . 1. *C. schweinfurthiana*
      3. Leaves 3–4 mm. wide ; spikes obovoid, 5–7 mm. long ; utricles 3–3·5 mm. long . . . . . 4. *C. pallidior*
   2. Upper surface midrib of leaf villous ; glumes fulvous, castaneous, or bright reddish to very dark reddish or reddish-brown :
      4. Spikes 3–6 mm. long ; spikelets 2·5–3 mm. long ; utricles 3–4 mm. long . . . . . 3. *C. microcephala*
      4. Spikes 5–9 mm. long ; spikelets 3–6 mm. long ; utricles 4·25–6 mm. long :
         5. Glumes fulvous to castaneous or bright reddish 2. *C. abyssinica* var. *abyssinica*
         5. Glumes very dark reddish . 2. *C. abyssinica* var. *castanea*

1. Stems densely to very densely tufted, developing from intravaginal shoots, 1–3 mm. broad (including leaf-sheaths) near the base, glabrous (except in *C. setifera*) ; leaves mostly convolute-cylindric, glabrous or hairy, 1·5–3 mm. wide (when flattened out), often much curved above ; bristles at the base of the utricle less slender, minutely setulose, multicellular :
   6. Upper surface of leaves densely minutely hispidulous, under-surface glabrous ; spikes crowded and sessile . . 7. *C. virgata*
   6. Upper surface of leaves glabrous, under-surface glabrous or sparsely to densely villous ; spikes loose and pedicelled :
      7. Stems and leaves glabrous ; spikelets 3–4 mm. long ; utricles 4–5 mm. long . . . . . 6. *C. glabra*
      7. Stems sparsely to very densely villous ; upper surface of leaves glabrous, under-surface sparsely to densely villous, rarely glabrous ; spikelets 2–3 mm. long ; utricles 3–4 mm. long 5. *C. setifera*

1. **Coleochloa schweinfurthiana** (*Boeck.*) *Nelmes*, comb. nov.

Carpha schweinfurthiana Boeck. in Flora, 62 : 569 (1879).

Eriospora schweinfurthiana (Boeck.) Benth. ex C. B. Clarke in Durand & Schinz, Consp. Fl. Afr. 5 : 676 (1895).

Type : Anglo-Egyptian Sudan, *Schweinfurth* 3820.

Stems 68–92 cm. tall. *Leaves* 4–6 mm. wide, flat to conduplicate above, midrib glabrous, upper surface yellow ; sheaths glabrous. *Inflorescence* an erect lax slender panicle, situated on the upper 25–50 cm. of the stem and composed of 5–7 fascicles of spikes, unequally pedunculed. *Peduncles* very slender, erect, curved or flexuous. *Spikes* few to numerous in each fascicle, mostly ellipsoid, sometimes oblong-oblanceoloid, 6–10 mm. long. *Spicelets* more or less oblong, 4–5 mm. long. *Flowering glumes* lanceolate or oblong-lanceolate, cymbiform to conduplicate, 3·4–3·75 mm. long, glabrous or minutely and sparsely hispidulous towards the apex and especially on the midrib, straminous, often slightly tinged reddish brown, mostly aristate, awn up to 1·5 mm. long. *Utricles* lanceoloid, trigonous, 4·5–5·25 mm. long (utricle proper 3·5–4 mm. beak 1–1·25 mm. long), angles sparsely hispidulous, straminous, straight, slightly constricted at its junction with the straight or slightly curved beak. *Basal hairs* less than half the length of the utricle. *Seed* compressed-cylindric, lineolate-punctate, **2–3 mm. long.**

Somaliland Protectorate : Nugaal District, summit of Mt. Bangaare, 29 May 1870, *Scrivenor* 8[illegible] (K) ; Ainé, frequent on upper rocky slopes, 6 May 1957, *Mooney* 6838 (K) ; 6[illegible], 924 m., 26 May 1959, *Andrews* 1491, (K).

2. **Coleochloa abyssinica** *Hochst. ex A. Rich.*) *Gilly* in Brittonia. 5 : 14 (1943), var. **abyssinica.**

Limnopoa abyssinica Hochst. ex A. Rich., Tent. Fl. Abyss. 2 : 508 (1851).

Type : Abyssinia, *Schimper* 233.

Eriopus abyssinicus Hochst. ex A. Rich.: Boeck. in Linnaea. 39 : 9 (1875).

Stems 35–95 cm. tall. *Leaves* 2–5 mm. wide, convolute-cylindric, conduplicate or flattish above, upper surface golden-brown, its midrib villous ; *sheaths* glabrous. *Inflorescence* an erect or slightly cernuous, lax, slender panicle situated on the upper 15–55 cm. of the stem and composed of 3–6 fascicles of spikes, unequally pedunculed. *Peduncles* very slender, erect, curved or flexuous. *Spikes* rather numerous or numerous in each fascicle, ellipsoid to obovoid, becoming oboconic in fruit, 5–9 mm. long. *Spicelets* more or less oblong, 3–6 mm. long. *Flowering glumes* oblong, oblong-lanceolate, or lanceolate, mostly more or less conduplicate, 2·5–6 mm. long, glabrous to sparsely minutely hispidulous, fulvous to castaneous or bright reddish, muticous to mucronate or aristate, with an awn up to 1 mm. long. *Utricles* oblong or oblong-lanceoloid below, subabruptly narrowing into a tapering-linear beak, trigonous, 4·25–6 mm. long, 0·5–0·75 mm. broad (utricle proper 2–3 mm. beak 2–3 mm. long), angles smooth or minutely and sparsely scabro-ciliate, especially above, straight or beak sometimes falcate, castaneous or straminous with castaneous patches, beak paler. *Basal hairs* rather shorter than or up to as long as the utricle proper (minus beak). *Seed* slightly tapering-cylindric, **lineolate-punctate, 1·8–2·3 mm. long.**

Tanganyika : Ufipa Comp., Mt. Sesia group of mountains, Mt. Mamalesi, near to Lomeni Mbugu, 2000–3000 m., 25 Aug. 1892, *Fyfe* 1[illegible] (EA, FI) ; Rog Somaliland : Guna Guna, 2200 m., 21 Nov. 1902, *Pappi* 615 (FI).

[illegible] Mt. Sesia group, upper moist grassy parts, on rocks and on creeping roots, 22 Dec. 1892, *Scrivenor* [illegible] (BM, FI, K) ; Bagamoyo District, [illegible] 2[illegible] m., 2 Oct. 1893, *Stuhlmann* 1[illegible] (BM, K) ; Nyassaland, [illegible] on rocks and stones [illegible] [illegible] of the Lingwe, [illegible] Mlanje, [illegible] *Purves* [illegible] (FI) ; Rog Comp. Rog : Mt. Arbia Basso, 30 May 1901, *Paoli*, Somali [illegible] (FI, [illegible] FI, K) ; Cuma Sudanica, Colonga, Ghinda, [illegible] Keren, [illegible] 21–30 Nov. 1939, *Benedetto* 602, 603 (FI).

2. **Coleochloa abyssinica** *Hochst. ex A. Rich.* Gilly var. **castanea** *C. B. Clarke Pichi-Sermolli* in Webbia, 7 : 347 (1950).

Eriospora abyssinica Hochst. ex A. Rich. var. *castanea* C. B. Clarke in Dyer, Fl. Trop. Afr. 8 : 513 (1902). Type : Abyssinia, *Quartin-Dillon & Petit*.

Leaves 3–7 mm. wide. *Flowering glumes* very dark reddish. *Utricles* oblong, oblong-ellipsoid, or ellipsoid below, 4·5–5 mm. long, 0·75–1 mm. broad, angles minutely scabro-ciliate, sometimes parts of the surface minutely hispidulous. *Seed* 1·5–2 mm. long.

Abyssinia : Shireh (Chiré) Province, edge of torrent on mountain plateau, margins of river Taccazi, July 1840, Quartin-Dillon et Petit K ! : Abyssinia, *Schimper* 990, " envoie de M. W. Schimper, 1853" K ! : Begemder, Gerra, on rocks, 2250 m., 29 Aug. 1863, *Schimper* 1262 BM, K ! : Amhara Tzellemti : Mt. Taclit, stony rocks, 4 Jan. 1939, *Cufodontis* 718 FI ! : Galla-Sidama : Uollega, Ghidami, 11 20 July 1939, *Benedetto* 478 (FI) !

Uganda : Acholi District ; rock pavements on crest of rocky peak, Lomwaga Mtn., south-east Imatongs, 2580 m., 5 April 1945, *Greenway & Hamme* 7290 EA, K, PRE ! Karamoja District : Moroto Mtn., July 1930, *Lebenberg* 552 hele no. 884 K ! ; Napak, mountain grassland, common in tufts on wet rocks, 2100 m., 28 May 1940, *Thomas* 3638 (K) !

Tanganyika : Ufipa District ; Mmemya Mtn., rock crevices at summit, 2220 m., 20 Feb. 1951, *Bullock* 3703 (K) !

Angola : Loanda, *Welwitsch* 7157, pro parte BM ! : Cuanza Norte : Pungo Andongo, on rocky slopes of all rocks of the praesidium, 18 Dec. 1856, *Welwitsch* 6841 BM ! ; ind., frequent in rock fissures on the heights of the praesidium, in flower March and April 1857, *Welwitsch* 6841 (BM) !

Typical specimens of this plant and of var. *abyssinica* look clearly distinct from one another, but closer examination of the limited material available fails to reveal sufficiently distinctive characters to warrant specific treatment.

3. **Coleochloa microcephala** *Nelmes*, sp. nov. : affinis *C. abyssinicae* Hochst. ex A. Rich. Gilly, sed spicis spiculis glumis utriculis minoribus praecipue differt. Type : Tanganyika, *E. M. Bruce* 605.

Eriospora abyssinica Hochst. ex A. Rich. var. *brevirostrata* Gross ex A. Peter in Fedde, Repert. Spec. Nov., Beih. 40 (1), Anhang, 142 (1938). Tanganyika, *Schlieben* 3167, 3676.

Stems 40–95 cm. tall. *Leaves* 3–9 mm. wide, flat to conduplicate, or convolute-cylindric above, upper surface light green, midrib villous ; *sheaths* glabrous. *Inflorescence* a more or less cernuous, lax, rather slender panicle, situated on the upper 30–50 cm. of the stem and composed of 5–8 fascicles of spikes, unequally peduncled. *Peduncles* very slender, erect, curved or flexuous. *Spikes* several to numerous in each fascicle, ellipsoid to obovoid, sometimes becoming obconic in fruit, 3–6 mm. long. *Spikelets* more or less oblong, 2·5–3 mm. long. *Flowering glumes* ovate-lanceolate or lanceolate, mostly more or less conduplicate, 2–3·25 mm. long, mostly glabrous except for sparsely ciliolate-hispidulous margins, light to dark reddish or reddish-brown, sometimes pale below, muticous or mucronate, mucro 0·4–0·5 mm. long. *Utricles* lanceoloid, including the ill-defined beak, or utricle proper ellipsoid and beak tapering, trigonous, 3–4 mm. long (utricle proper 2–2·5 mm. beak 1–1·5 mm. long), glabrous below or at the base, angles sparsely setulose above, straight or straightish, straminieous above and below, medianly dark reddish. *Basal*

hairs up to nearly as long as the utricle. *Seed* compressed-cylindric or compressed-trigonous, slightly tapering upwards, lineolate-punctulate, stramineous, 1–1·5 mm. long.

Tanganyika : District Ulanga ; Mahenge, Ngongo, bare rocky hillock in mist-forest, c. 35 km. south of Mahenge, c. 1200 m., in wet places, only one specimen, 26 March 1932, *Schlieben* 1984 (B, BM, BR, K) ! District Morogoro ; Uluguru Mtns., 1400 m., 2 Nov. 1914, *Peter* 6971 (B) ! ; ibid., 1250–1450 m., 19 Nov. 1925, *Peter* 32310 (B) ! ; ibid., north-west side, savannah hills, among large grasses on rock face, 1750 m., 25 Dec. 1932, *Schlieben* 3167 (B, BM) ! ; ibid., north-west side, savannah hills, crowded in rock clefts, common, 1050 m., 26 March 1933, *Schlieben* 3676 (B, BM) ! ; ibid., Banduki, tufts in rock crevices, abundant, 1440 m., 23 Jan. 1935, *E. M. Bruce* 605 (BM, K) ! ; ibid., Morogoro, Kitundu, rock expanse in forest, abundant and dominant, 1650 m., 1935, *E. M. Bruce* 964 (BM, K) !

4. **Coleochloa pallidior** *Nelmes*, sp. nov. ; affinis *C. schweinfurthianae* (Boeck.) Nelmes, sed foliis angustioribus, spicis obovoideis brevioribus, utriculis brevioribus, praecipue differt. Type : Transvaal, *Codd & Dyer* 3835.

Stem 60 cm. tall. *Leaves* 3–4 mm. wide, convolute-cylindric, or conduplicate to flattish above, midrib glabrous, upper surface golden-yellowish, under-surface green ; *sheaths* glabrous. *Inflorescence* an erect or slightly cernuous, lax, slender panicle, situated on the upper 16 cm. of the stem and composed of 3 fascicles of spikes, unequally peduncled. *Peduncles* very slender, erect, sometimes slightly curved or flexuous. *Spikes* not numerous in each fascicle, obovoid, 5–7 mm. long. *Spikelets* more or less oblong, 2·75–3 mm. long. *Flowering glumes* oblong or oblong-lanceolate, mostly conduplicate, 2·5–3 mm. long, glabrous or sparsely and minutely hispidulous, pale, often light or dark reddish-splashed, muticous or mucronate. *Utricles* oblong-lanceoloid to ellipsoid, trigonous, angles prominent, subabruptly narrowing into a linear-tapering beak, 3–3·5 mm. long (utricle proper 2–2·5 mm. beak about 1 mm. long), angles and faces sparsely hispidulous above including the beak, straight, stramineous. *Basal hairs* with branches arising from an entire membranous structure, up to nearly as long as the utricle. *Seed* ovoid-cylindric, subterete, slenderly lineolate-punctulate, 1·25–1·5 mm. long.

South Africa : Transvaal ; Zoutpansberg District, Farm Greefswald 615, 1½ miles west of Mapungubwe, sandstone ridge, overlooking Limpopo River and Shashi Mouth, rock crevices, 510 m., 15 March 1948, *Codd & Dyer* 3835 (PRE) !

5. **Coleochloa setifera** (*Ridley*) *Gilly* in Brittonia, 5 : 14 (1943).

Fintelmannia setifera Ridley in Journ. Linn. Soc. Bot. 20 : 337 (1884). Type : Madagascar, *Hilsenberg & Bojer*.

Trilepis oliveri Boeck., Cyper. Nov. 1 : 38 (1888). Type : Nyasaland, *Buchanan* 25.

T. setifera (Ridley) Kuntze, Rev. Gen. 758 (1891).

Eriospora villosula C. B. Clarke in Trans. Linn. Soc. Ser. II, 4 : 54 (1894). Type : Nyasaland, *Whyte* 68.

E. oliveri (Boeck.) C. B. Clarke in Durand & Schinz, Consp. Fl. Afr. 5 : 676 (1895).

E. setifera (Ridley) C. B. Clarke, l.c. 676.

E. rehmanniana C. B. Clarke in Dyer, Fl. Cap. 7 : 297 (1898). Type : Transvaal, *Rehmann* 5624.

C. oliveri (Boeck.) Gilly, l.c.

C. villosula (C. B. Clarke) Gilly, l.c.

C. rehmanniana (C. B. Clarke) Gilly, l.c.

Stems 10–65 cm. tall, sparsely to very densely villous. *Leaves* 1–1·25 mm. wide (when flattened out), convolute-cylindric above, thus aping the stems, upper surface glabrous, under-surface sparsely to densely villous, rarely glabrous ; lower *sheaths* glabrous, upper more or less villous. *Inflorescence* an erect or slightly curved, lax, slender panicle, situated on the upper 3–15 cm. of the stem and composed of 1–3 fascicles of spikes, unequally peduncled. *Peduncles* very slender, erect or suberect. *Spikes* few to rather numerous in each fascicle, usually obovoid, sometimes ellipsoid, often becoming obconic in fruit, rarely oblong-ellipsoid, 4–8 mm. long. *Spikelets* more or less oblong or lanceolate, 2–3 mm. long. *Flowering glumes* ovate, lanceolate, or oblong-lanceolate, mostly conduplicate, 2–3 mm. long, glabrous or sometimes minutely hispidulous on and near the midrib, pale or palish with reddish patches or wholly dark reddish or reddish-brown, muticous to aristate, awn up to 1·25 mm. long. *Utricles* lanceoloid, trigonous, 3–4 mm. long (utricle proper about 2 mm. beak 1·5–2 mm. long), glabrous, or sometimes minutely hispidulous above and on the angles above and on the beak, straight or slightly falcate, stramineous, often with a reddish patch. *Basal bristles* two-thirds to nearly as long as the utricle. *Seed* ovoid to oblong-ellipsoid, slightly compressed, lineolate-punctulate, stramineous, 1–1·25 mm. long.

Tanganyika : Nzega District ; Uyui, near Tabora, Dec. 1886, *W. E. Taylor* (BM) ! Masasi District ; near Nangua, Tunduru-Masasi road, 450 m., Nov. 1951, *Eggeling* 6389 (K) !

Nyasaland : Blantyre District ; Shire Highlands, *Buchanan* 25 (K) ! ; ibid., Ndirande, on rocks, Dec. 1894, *Scott Elliot* 8459 (BM, K) ! Mlanje District ; Mlanje Mtn., Oct. 1891, 1800 m., *Whyte* 68 (BM, K) ! ; ibid., 24 Sept. 1929, *Burtt-Davy* 22029 (K) ! ; ibid., Luchenya Plateau, clumped on open rock slopes, 1860 m., 26 June 1946, *Brass* 16438 (K, PRE) ! ; ibid., abundant on shallow rocky soil on grasslands, 2100 m., 3 July 1946, *Brass* 16654 (K, PRE) ! Zomba District ; Mt. Malosa, 1200–1800 m., Nov.–Dec. 1896, *Whyte* (K) ! ; Ntondwe, on bare slab rock on hill-sides and summits, 1905, *Cameron* 166 (K) ! ; Zomba Plateau, plentiful in small clumps on an exposed rocky summit, 1820 m., 31 May 1946, *Brass* 16133 (K, PRE) !

Portuguese East Africa : Niassa–Marrupa, between the Chief Mutaprata and Romba Mt., granitic outcrops, 12 June 1948, *Pedro & Pedrogao* 4270 (EA, K) !

Southern Rhodesia : Inyanga District ; Inyanga, on the sloping bank of the river Pungwe, c. 1700 m., 18 Dec. 1930, *C. E. Fries, Norlindh & Weimarck* 3818 (B, BM, L) ! ; near Inyanga, on flat wet rocks on the col of Niamoka, c. 1750 m., 22 Jan. 1931, *Norlindh & Weimarck* 4513 (BM, L) ! ; Mare River, Inyanga, on dry granite rocks by river, 1830 m., 16 Feb. 1947, *Wild* 1660 (K) ! Marandellas District ; Dombi Dombi, in shallow soil on granite outcrop, 1500 m., 13 March 1949, *Corby* 413 (K) ! Matopo District ; Matopos, huge tufts in cracks of solid granite hill below World's View, 1290 m., 9 March 1932, *Brain* 8614 (K) ! Mazoe District ; Mazoe, leaves etc. carried on a short trunk like a tree fern, 11 Nov. 1929, *Eyles* 6899 (K) ! Melsetter District ; Chimanimani Mtns., common on the cliff ledges, 2100 m., 26 Sept. 1907, *Swynnerton* 918 (BM, K) ! Salisbury District ; Salisbury, on flat granite rock, root-mass exceedingly tough, 1560 m., 1 June 1927, *Eyles* 4949 (K) ! ; Domboshawa, 20 miles from Salisbury, on bare granite, 13 Aug. 1929, *Rendle* 382 (BM) ! ; ibid., in clefts of granite rocks, 1350 m., 16 Feb. 1947, *Wild* 1660 (K) ! Umtali District ; occasional between rocks, just outside forest margin, Vumba Mtns., 11 Feb. 1948, *B. S. Fisher* 1519 (PRE) !

Northern Rhodesia : Isoka District ; Mafinga Mtns., exposed mountain top, on humic sandy soil between blocks of quartzose sandstone, 2220 m., 13 Jan. 1938, *Trapnell* 1820 (K) !

Madagascar : *Hilsenberg & Bojer* (BM) ! ; *Deans Cowan* (BM) ! ; from Admiral Bowles to Sir W. Hooker, 1863 (Herb. Mr. Justice Blackburn), *Bojer* ? (K) ! ; Masakoamena, bare gneiss rocks, c. 500 m., Dec. 1910, *Perrier de la Bathie* 2557 (K) ! Chermezon (in Humbert's Flore de Madagascar, 29c Fam. Cypéracées, 1937, p. 271)

over 14 other gatherings, mostly from the central area of the island, occurring on bare rocks at 600–2000 m.

South Africa. Cape Province: Jacksonsturn, rocky north slopes of Magaliesberg, in seepages in all common, 1500 m., Feb. 1906, *Acocks* 12938 (BM, PRE); Johannesburg District: Johannesburg, Milner Park, rocky, 26 Jan. 1922, *Mogg* 6946 (K); Cullinan, Kruger & Scott 1921, *Mogg* 8966 (BM, PRE); Pretoria, rocky, 1500 m., Dec. 1923, *Mogg* 9961 (K); Witpoortjie, Johannesburg, March 1924, *Acocks* 13139 (PRE); Bronkhorst Kloof, 6 Oct. 1926, *Pienaar* 1617 (PRE); Potchefstroom District: Eastside, large tufts frequent, growing with *Scirpoides natalensis* in shallow humus soil on bare rock, more or less exposed, 1500 m., 27 Jan. 1967, *Lewis* 1767 (PRE); Krugersdorp, on slopes of quartzite hill, frequent in places, 28 Feb. 1940, *Lewis* 1677 (PRE); Pretoria District: Wonderboompoort, 1867, *R. Rehmann* 6480 (BM, K); Hoedspruit, 1875–8, *Rehmann* 3626 (BM, K); Wonderboom, 2 Dec. 1922, *Pole Evans* 977 (PRE); Johannesburg, near Pretoria, very common, 25 Sept. 1905, *Marloth* 6 (PRE, fruiting); Rustenburg District: Magaliesberg, on rocks at Pretoria-Kloof, 1500 m., in mountainside pockets, forming a tough interwoven cushion, 1500 m., 29 Sept. 1927, *Compton* 2 (K, young spikelets); Pretoria, Wonderboompoort, on east slope of Magaliesberg Range, in a rocky ravine on the mountain, having become very much common, 6 Dec. 1925, *C. A. Smith* 1056 (PRE); Wonderboom Reserve, upper slope of Magaliesberg, rock outcrops in mats common, 24 Feb. 1944, *Repton* 1651 (PRE).

The only element under *C. setifera*, as treated here, which seems to me at all doubtfully placed is that represented by the type of *C. villosula* C. B. Clarke, Gilli and several other sheets, e.g. the *Bro* numbers from the type locality, Miarge Mts., Nyasaland. These plants exhibit in their spikes a rather different facies, due to a combination of several characters, especially somewhat darker brown glumes and more conspicuously if not longer awned bracteoles, but when one more closely examines their glume, fruit, and seed characters the difference in facies seems to have no supporting basis. Incidentally, the spikes of *C. villosula* bear an indefinable resemblance to the larger sessile ones of *C. virgata*, a species which is really quite distinct.

Of the two gatherings cited by Ridley under *C. setifera*, that collected by Hilsenberg and Boier is much the better, so I take this opportunity to choose it as lectotype.

6. **Coleochloa glabra** *Veldkamp* sp. nov.: affinis *C. setiferae* Ridley Gilly. sed culmis foliisque glabris, spiculis majoribus glabris, praecipue differt. **Type: Anglo-Egyptian Sudan, *Myers* 9127.**

Stems 25–45 cm. tall, glabrous. Leaves 1·5–2 mm. wide when flattened out, convolute-cylindric, thus aping the stems, rarely flattish above, glabrous, grey-green to yellowish-green; *sheath* shortly subappressed-villous on the back. *Inflorescence* an erect, lax, slender panicle, situated on the upper 8–14 cm. of the stem and composed of 2–7 fascicles of spikes, unequally peduncled. *Peduncle* extremely slender, erect to curved or flexuous. *Spikes* few to rather numerous in each fascicle, obovoid, becoming obconic in fruit, 3–6 mm. long. *Spikelet* more or less oblong, 3–4 mm. long. *Flowering glume* lanceolate or oblong-lanceolate, mostly conduplicate, 2·5–3 mm. long, glabrous, bright reddish or streaked and splashed reddish, paler at the base and bracteoles pale, aristate awn 0·25–1 mm. long. *Utricle* lanceoloid, trigonous, 2–3 mm. long; utricle proper 2–3 mm., beak about 2 mm. long, glabrous, straight to lanceate, stramineous. *Basal bristles* up to more than half as long as the utricle. *Seed* immature.

Anglo-Egyptian Sudan: Equatoria Province; Mt. Odo, south of Amadi, in grooving crannies, clumps, almost the only plant on upper smoother rock surfaces including those nearly vertical, 27 July 1938, *Myers* 9127 (K, !); Mt. Ado-Amadi District, top of mountain, in crack of rock, 27 April 1936, *Jackson* 685 (K).

7. **Coleochloa virgata** (*K. Schum.*) *Nelmes*, comb. nov.

Eriospora virgata K. Schum. in Engl. Pflanzenw. Öst-Afr. C : 128 (1895).

Type : Tanganyika, *Fischer* 624.

Stem 40–50 cm. tall, glabrous. *Leaves* 2–3 mm. wide (when flattened out), convolute-cylindric above, thus aping the stems, upper surface densely minutely hispidulous, its midrib shortly villous, under-surface glabrous, grey-green ; *sheaths* glabrous. *Inflorescence* an erect, dense but interrupted, slender panicle, situated on the upper 3·5–10 cm. of the stem and composed of 1–2 secondary panicles of mostly sessile clustered spikes on slender *peduncles*. *Spikes* few to numerous in each panicle, obovoid, oblong-ellipsoid, or shortly cylindric, 5 7 mm. long (excluding the long bracteole-awns). *Spikelets* more or less oblong, about 4 mm. long. *Flowering glumes* lanceolate or oblong-lanceolate, mostly conduplicate, 3·5 4 mm. long, glabrous to scurfy-hispidulous, dark reddish, usually aristate, awn often about 1 mm. or more long. *Utricles* immature. *Basal bristles* probably more than half as long as the mature utricle. *Seed* undeveloped.

Tanganyika : Mt. Meru, *Fischer* 624.

Nyasaland : Mlanje District ; Mlanje Mtn., Luchenya Plateau, bright green clumps frequent on shallow rocky soil on grasslands, 2100 m., 3 July 1946, *Brass* 16635 (K, PRE) !; ibid., peaty fibrous base of tussocks sometimes 1 m. high and eroded into vase-shaped forms, forming massive tussocks on open grasslands, 1890 m., 8 July 1946, Brass 16737 (K, PRE) !

The above description is of the Brass, Nyasaland, specimens as the type of the species (*Fischer* 624) is not available. It was apparently destroyed in the second world war. One cannot, therefore, be certain that the Nyasaland plant is *C. virgata*, but it agrees so well with the original description that there seems little doubt about it.

This remarkable species differs from all the others in *Coleochloa* by the densely hispidulous upper surface of the leaves and by its clustered and sessile spikes.

Literature.

Gilly cites such a comprehensive list of literature that only the items referred to in my paper, including three additional ones, are mentioned here.

1. Bentham, G. Notes on *Cyperaceae*, with special reference to Lestiboudois's " Essai " on Beauvois's genera (Journ. Linn. Soc. Bot. 18 : 360–367 : 1881).

2. Clarke, C. B. Illustrations of *Cyperaceae*. 144 plates. (Plate 140, by Miss M. Smith, *Eriospora pilosa* Benth. and *E. rehmanniana* C. B. Clarke). London, 1909.

3. Gilly, C. L. An Afro South-American Cyperaceous complex. (Brittonia, 5 : 1–20 : 1943).

4. Hutchinson, J. *Cyperaceae*. In Hutchinson, J. & Dalziel, J. M. Flora of West Tropical Africa, 2 : 464–495 : 1936.

5. Lestiboudois, T. Essai sur la famille des Cypéracées. 46 pp. Paris, 1819.

East African Orchids.*—The obtaining of a proper understanding of the classification of the orchids of a large and varied region such as East Africa is a long and laborious task. Extensive studies of the plants in the field are necessary, specimens have to be collected for detailed comparison with orchids from other parts of Africa, or even from such countries as India, Madagascar and Malaya, while critical bibliographical research may be required to ascertain the correct names of some species. It cannot be expected that such a study will be completed without some re-orientation of ideas being necessary at various stages in its progress, resulting in changes of generic and specific concepts and of the names of the plants concerned.

The appearance at intervals of more or less popular books on the orchids of the whole or part of the region can therefore serve two useful purposes. Firstly such books maintain an active interest in the subject and often afford the opportunity of publishing new information of general interest. Secondly, they may help to present the latest views on the classification of the plants concerned, obtained during the more detailed studies mentioned above.

Dr. Piers' little book makes useful contributions in both of the above directions. Although the author claims to include only those species which he has himself cultivated or observed in the field, he provides a considerable amount of interesting information about these species. At the same time the botanical concepts and nomenclature are more up-to-date than in most books of this type. Nevertheless there are still a number of names which need correcting, such as *Tridactyle fimbriata* (fig. 24) which should be *T. bicaudata*. There are also a number of misspellings for which the author is probably not to blame, but attention should be drawn to fig. 15 which is certainly not *Chamaeangis vesicata*. In that species the end of the spur is swollen into a sort of bladder. The plant figured appears to be the recently described *C. orientalis*, which is also possibly the plant described under section (b) on the opposite page. The continuous march in our knowledge is, moreover, well exemplified by the fact that the *Aërangis* shown in figs. 5 & 6 has been described recently as *A. coriacea*, while the plants illustrated in figs. 31 & 32 have been proved to belong to the genus *Stolzia* and not to either *Polystachya* or *Bulbophyllum*. It is unfortunate that it has not been possible to reproduce satisfactorily Dr. Piers' excellent photographs. The blocks in many examples scarcely do justice to the originals.

In spite of these blemishes the author has produced an attractive book. It is to be hoped that in a new edition he will bring his names and classification further up-to-date so as to keep orchid enthusiasts in East Africa in touch with the latest progress made in this direction. May we also hope that he will deal more fully with some of the terrestrial genera which, as he admits, are rather scantily represented.

V. S. Summerhayes.

*A Book of East African Orchids, by F. Piers, M.D., Patwa Publications, Nairobi, pp. 112, 60 photographs, 1951, 14/6d.

THE RUSTAM HERBARIUM, 'IRAQ.—Part VI.

General and Ecological Account.

by E. R. Guest.

Topography.

A. General Geographical Description.

The territory of the modern state of 'Iraq—roughly the Mesopotamia of history—is bounded on the west by the Syrian Desert which separates it from Syria, Palestine and Transjordania, on the south by the deserts of Arabia, on the south-east by the shore of the Persian Gulf, on the east and north-east by the mountain chain of the Persian plateau and on the north by the mountains of Turkey. It is situated between longitudes 38°42′ E. and 48°23′ E. and latitudes 29°27′ N. and 37°23′ N. and lies mainly along a vast depression which runs down in a N.W.-S.E. direction from the Turkish highlands to the Persian Gulf with the plateau of the Syrian desert on one side and the mountain wall of Persia on the other. The greatest length of 'Iraq is rather over 600 miles, its greatest width about 450 miles and its total area approximately 180,000 square miles.

The floor of this depression is the flood plain of the rivers Tigris and Euphrates which flow from the north and north-west respectively—a level alluvial plain at an average altitude of not more than 50–100 ft. above sea level. These rivers begin to converge towards Baghdad but diverge again without meeting and then spread out into the marshes of southern 'Iraq. Eventually the two main river channels flow together at Qurna some 40 miles above Basra to form the Shatt-al-Arab River which runs into the Persian Gulf at Fao. Beyond the limits of the alluvial plain where the level of the land is slightly higher, there is a plain of different character. This stretches northwards to the line of the Jabal Hamrin, an abrupt range of low hills (alt. 500–700 ft. above sea level) running in a north-westerly direction from a point some 60 miles north-east of Baghdad. In the area between the Tigris and Euphrates the plain is known as the Jazira and west of the Euphrates it rises gradually to the plateau of the Syrian Desert. Beyond the Jabal Hamrin where the country is considerably higher lie the rolling plains of the sub-montane belt, traversed here and there by small ranges of hills and stretching to the foothills of Kurdistan. This tract includes the plains of Arbil and Mosul and the upper limits of the Jazira ; its altitude varies from 700–1500 ft. above sea level. The line of the foothill country runs roughly from Zakho through Dohuk, Koi Sanjak and Chemchemal. Beyond to the north-east are the Kurdish mountains, rising to 10,000–12,000 ft. on the 'Iraq side of the frontier and to an even greater altitude beyond in Turkey and Persia. The highest peak in 'Iraq is the Arl Gird Dagh (alt. 12,200 ft.) near the Persian border E.N.E. of Rowanduz.

B. Physiography.

The alluvial plain of Lower 'Iraq stretches roughly from Daltawa, some 40 miles north of Baghdad, where a drop of 20 50 ft. marks an ancient coast line, to the shores of the Persian Gulf. It is the old delta of the rivers Tigris and Euphrates, which has been pushing out for centuries into the Persian Gulf. It is an absolutely flat plain and the fall of the

land from Baghdad to the sea is only about 115 ft. in some 350 miles. The remains of ancient canals and the mounds of buried cities alone break the monotonous flatness. " tels " or eminences of 20–30 ft. being marked as hills on the map. The rainfall is low and except where irrigation is available it is an arid waste, only clothed with a sparse covering of green for a short period in spring after the winter rains: by May this ephemeral vegetation has gone and at other times of the year only the perennial bushes are found. The cultivated areas of the alluvial plain consist principally of a narrow strip along the river's edge where irrigation water is available. In addition to this on the Euphrates there are considerable areas between Hilla and Samawa watered by canals which take off from the Hindiya Barrage and on the Diyala a tributary of the Tigris in the neighbourhood of Daltawa, Baquba, Balad Ruz and Sharaban.

The marshes of Lower 'Iraq. The channels of the rivers are continually being blocked by the silt which they bring down so that they are liable to flood in spring and early summer. The effect of this flooding throughout the ages has been to raise the level of the rivers and their banks slightly above that of the surrounding country, thus increasing the danger of floods. In southern 'Iraq large deltas have been formed through which branches flow out into extensive shallow marshes occupying many square miles of country. The greater part of the area between Amara and Nasiriya is permanent marsh. Other permanent marshes occur to the south of Kut and to the east of the Tigris between Amara and Qurna ; here the marsh is continuous with the Persian marshes of lower Arabistan. Numerous birds and water fowl abound throughout the marsh areas. inhabitants live in reed huts along the water's edge and ply their trade in boats. Deltas are continually pushing out southwards into the marsh with each successive deposition of silt, so that what was good rice land at one time is soon afterwards cultivated for wheat and barley. There are no permanent marshes on the Tigris above Kut : above Nasiriya there are frequent reedy broads on the Euphrates as far as Hilla.

The south-east coast-line. The only sea coast of 'Iraq is on the Persian Gulf, extending from the mouth of the Shatt-al-Arab to the boundary of Kuwait, a distance of some 26 miles. It is low alluvial land intersected by numerous irrigation creeks from the river. In some places it is bare mud, in others it is covered with grasses and reeds and ultimately merges with the desert behind : it has no beaches. At certain points the sea runs inland for several miles at high tide forming a broad sheet of shallow water.

The southern desert. South of the lower reaches of the Euphrates the alluvial plain is bounded by the southern desert, stretching to the boundaries of Nejd and Kuwait. This is the northern limit of the Arabian desert, an extremely dry and inaccessible region. Only the fringe of this area has been visited in the locality of Zubair near Basra. It is an arid pebbly plain in which there are some ranges of low rocky hills. Jabal Sanam (alt. 460 ft.) is the highest point in this region : it lies south of Zubair on the border of Kuwait.

The western desert. West of the Euphrates the land slopes gradually up to form the plateau of the Syrian desert, an immense tract of infertile country separating 'Iraq from Syria, Palestine and Trans-Jordania.

The general surface of the land is more or less level or slightly undulating with here and there low barren hill ranges. It is a great, open, more or less stony waste traversed by wadis (watercourses) which are dry for the greater part of the year. Only the routes from Baghdad to Damascus and Amman (a distance of 500–600 miles) are at all frequented, the rest of the area being entirely desolate and uninhabited except by the Badouin who bring their flocks and camels there to pasture at certain seasons of the year. From Baghdad westward the plateau gradually rises until it attains a height of 2500–3000 ft. In spring, if the rains have been sufficient, it is clothed with short green pasture in many places, but by the early summer all this has been burnt up by the sun and no vegetation except the perennial bushes remains.

The Jazira. The tract of country which lies between the Tigris and the Euphrates north-west of Baghdad is known as Al-Jazira ("the island"). Beyond the upper limit of the alluvial plain the land begins to slope more rapidly to the north, rising to an altitude of 900–1000 ft. above sea level at the foot of Jabal Sinjar, a distance of about 250 miles from Baghdad (alt. 115 ft.). This stretch of country, the Jazira, has a gently undulating surface. It is traversed by several chains of low hills, the only high range being Jabal Sinjar which reaches an altitude of over 4000 ft. above sea level. It is traversed for the greater part of its length by the Wadi Tharthar, a large water course which begins near the eastern end of Jabal Sinjar and ends in a large saline depression (Sabka Um Rahal, 20–30 miles north of Ramadi on the Euphrates. For several months in the year the Wadi Tharthar is entirely dry with the exception of a few brackish pools of sulphurous water. The Jazira, south of Jabal Sinjar is uninhabited, but in spring and early summer the Badouin pasture large flocks of sheep and herds of camels there; for, in spite of the aridity of this region it contains numerous wells and springs which can be tapped at that time of year.

The Ghurfa and the area north-east of the Tigris. The tract of country which lies to the east of the Tigris, north of Daltawa and between that river and the Diyala, is known as Al-Ghurfa ("the room"). It is a small strip of low open plain which stretches northwards to the foot of the Jabal Hamrin. It is uninhabited except in the region south-east of the Adhaim River where a few villages are situated. The whole of this area affords good grazing in spring. As the Jabal Hamrin runs south-east beyond the Diyala this strip of plain narrows, so that when the Jabal eventually merges in the line of the Persian foothills the margin of the lower alluvial plain has approached to within a short distance of them and thereafter skirts along their base southwards.

The Jabal Hamrin range. This is a low range of dry hills, starting from a point some 90 miles north-east of Baghdad and running up in a north-westerly direction. It forms an abrupt wall at the upper limit of the Ghurfa plain. The height of the Jabal Hamrin varies from 500–700 ft. above sea level. West of the Tigris it is continued as the Jabal Makhul, a considerably higher range running in a more northerly direction. The river pierces the Makhul-Hamrin range by the Fatta Gorge. North of the Jabal Hamrin the country is much more elevated than the plain to the south.

The sub-montane plains. The country north of the Jabal Hamrin, stretching as far as the line of the Kurdish foothills, can be designated as the sub-montane belt of 'Iraq. It is an undulating plain, broken here and there by hills and hill ranges, which varies in altitude from about 600–1500 ft. above sea level. The country slopes up gradually towards the north-east. As the neighbourhood of the mountains is approached the rainfall increases rapidly and the character of the land changes. The extreme southern portion of this area near the Jabal Hamrin is semi-desert, arid and unfit for cultivation. North-east of Kirkuk the soil becomes much richer and the rainfall greater. In the plain of Arbil where the soil is exceptionally fertile, there is a large settled agricultural population. The plain of Mosul is also cultivated extensively, but west of a line stretching roughly from Dohuk to Tal Afar the cultivated areas become more delimited.

The Kurdish Mountains. The line of the foothills extends roughly through Faish Khabur (on the Tigris near Zakho), Dohuk, Al Qosh, Acra, Koi Sanjak, Chemchemal and Kasr-i-Shirin (just beyond the Persian border, north of Khanaqin). North east of this line the country is all mountainous, varying in altitude from 1500–2500 ft. in the lowest valleys to 6000–12000 ft. at the top of the mountain ranges. The highest peak in 'Iraq is the Arl Gird Dagh (alt. 12,200 ft.), situated on the Persian border north-east of Rowanduz; beyond the Turkish border to the north even greater altitudes are reached. This region is extremely crumpled and contorted and contains many deep gorges where streams have cut down sharply into the limestone rock. The mountainous area continues northwards in Turkey until the shore of the Black Sea is reached and eastwards in Persia to the Caspian. In 'Iraq the general trend of the mountain ranges is from north-west to south-east or from east to west. While the upper mountain slopes are often bare and rocky, extensive oak forests occur up to a height of about 6000 ft. The area contains many well-watered valleys, sometimes opening out into high rolling plains. The inhabitants practise a certain amount of cultivation in the valleys in which their villages are situated; in summer they take their flocks to the high mountain pastures. The mountain passes are blocked with snow for several months on end in winter and on the higher summits small patches of snow can generally be found even throughout the summer.

The Rivers of 'Iraq. The two main rivers of 'Iraq are the Tigris and the Euphrates. The *Euphrates* rises in the mountains of Armenia, flows by a circuitous route through northern Syria and enters 'Iraq near Albu Kamal, 750 miles, above its confluence with the Trigris at Qurna. It reaches the alluvial plain at Hit about 500 miles above Qurna. South of Baghdad it converges to within 25 miles of the Tigris. Below the Hindiya Barrage (near Hilla) it divides into two main branches which join again near Samawa. From Hilla southwards the Euphrates begins to divide up into marshes and broads and below Suq-as-Shiyukh it becomes completely merged in the broad expanse of the Hammar Lake. Where it preserves its character as one river it has an average width of 200–350 yards. The average depth of the river below Hit varies from 6–12 feet with shoals at many points and the current varies according to place and season from 1 to 4 knots. The Euphrates receives no

tributaries in 'Iraq. The Shatt-al-Arab from the confluence of the Tigris and Euphrates at Qurna to its mouth at Fao on the Persian Gulf is rather over 100 miles long and has an average width of 450 yards. Its mean depth varies from 15–30 feet and it is tidal throughout its length. The *Tigris* rises in the Armenian mountains north of Diabekr and enters 'Iraq at Faish Khabur. It crosses the Jabal Hamrin by the Fatta Gorge and reaches the alluvial plain some 70 80 miles north of Baghdad. Below this point the width of the river varies from 200–450 yards, the mean depth from 4–6 feet and the current from 1½–2 knots according to place and season. It has many shoals and banks especially in the reaches between Baghdad and Kut. From Kut to Amara and southwards the river gives off many canals and distributaries which flow out into the southern marshes. The main stream is thus much diminished in size by the time it reaches its confluence with the Euphrates at Qurna. The largest of these branches is the Gharraf or Shatt-al-Hai, which leaves the Tigris at Kut and flows into the Hammar lake near Suq-as-Shiyukh. This river depends on the rise of the Tigris for its water ; in the low water reason it is dry. The Tigris receives four main tributaries in 'Iraq, the Khabur, the two Zabs and the Diyala. The *Khabur* rises in the mountains north of Zakho and Dohuk, where it flows for the most part through narrow gorges and joins the Tigris at Faish Khabur. The *Greater Zab* rises in the mountains of Hakkiari beyond the Turkish border and joins the Tigris 27 miles below Mosul. It receives many mountain torrents in the Kurdish hills, notably the Rubar-i-Rowanduz, the gorges of which have precipitous sides and are in places 1500 feet deep, cut down sheer into the limestone rock (Rowanduz Gorge). The *Lesser Zab* rises in the Kandil range of mountains east of Rowanduz and in the Persian mountains behind this range and joins the Tigris about 18 miles above the Fatta Gorge. The *Diyala* rises in Persia as the Sirwan river and crosses the 'Iraq frontier near Halabja. It enters the alluvial plain not far from Sharaban and flows into the Tigris about 20 miles below Baghdad (by river). The construction of a dam at Table Mountain (Jabal Hamrin) enables the water to be diverted into numerous canals which water the area between Balad Ruz, Sharaban and Daltawa, notably the rich fruit-growing district of Baquba and Daltawa.

The importance of the river system in the economy of 'Iraq is immense. On the plains of lower 'Iraq practically no crops can be grown without irrigation. In the plains of Mosul and Arbil and other northern parts of the country the rainfall is sufficient for winter crops but irrigation is necessary for the cultivation of summer crops and for the maintenance of gardens and orchards. Even in the Kurdish mountains the inhabitants are obliged to resort to irrigation during the summer months.

C. Climate*

The climate of 'Iraq is of the semi-arid type, designated as " continental, sub-tropical ". The main peculiarities of the climate are (a) a high mean annual air temperature (due to the latitude), (b) large differences in temperature between day and night and between winter

*Ref. : Climate and Weather of 'Iraq (pamphlet published at Baghdad in 1920 (?) author unknown) Meterological Report on 'Iraq—1933 (by courtesy of the R.A.F.).

and summer (i.e. large daily and annual ranges of temperature), (c) low humidity of the atmosphere, (d) scanty rainfall. The extent of 'Iraq over 7° of latitude would lead one to expect a considerable difference between the climate and vegetation of the north and of the south. This natural difference is accentuated by the general increase in altitude as one proceeds from north to south and by the comparative proximity of maritime regions to the northern parts of the country. For, although the short sea coast of 'Iraq is stituated in its south-eastern corner along the shore of the Persian Gulf, a glance at the map will show that the Persian Gulf is only a narrow land-locked arm of the Arabian Sea, cut-off from the open ocean by the whole width of the arid desert peninsula of Southern Arabia. Beyond the mountains of Kurdistan and Armenia lies the Black Sea at no great distance to the north-west and the Caspian to the north-east, while to the west beyond the Syrian Desert is the Mediterranean. Thus, as one proceeds northwards to the sub-montane belt and the mountain regions, the climate becomes more temperate. Although annual and diurnal ranges of temperature are still considerable the mean temperature is lower, the humidity and rainfall are greater and the rate of evaporation is less. In the plains the dryness and heat result in a large capacity for evaporation, the rate of which greatly exceeds the annual rainfall, being from 20–40 times as great. With the exception of the ephemeral vegetation of the spring which dries up and disappears early in summer, most of the plants that manage to survive the struggle for existence are highly xerophytic. The whole of the plains would be an almost barren wilderness for the greater part of the year were it not for river-borne water.

The year is divided into two well-marked seasons with short transition periods between—the long, hot, rainless summer extending from May to October and the comparatively short, cool winter extending from December to February. In the highlands the summer is rather shorter and the winter considerably longer than on the plains. The transitional periods, spring and autumn, are less well-marked on the plains than in the highlands, but are nevertheless distinguishable from either winter or summer. The spring months are March and April and the month of November or at any rate its earlier part, may be said to correspond to a short autumnal phase.

The coldest month in the year in all parts of the country is January during which the mean daily temperature on the plains ranges from about 35°–60°F. with recorded minimums of 19° at Baghdad and 12° at Mosul. The hottest months in the year are July and August during which the mean daily temperature ranges from about 75°–110°F. with recorded maximums of 120° at Baghdad and 122° at Basra.

The prevailing wind in all months is N.W. but during the winter months depressions pass eastward across the country from the eastern Mediterranean. They are accompanied by unsettled weather, strong south-easterly winds often of gale force, rain and duststorms. Mist at night and in the early morning sometimes succeeds the rain in winter, but it is usually local and rarely outlasts sunrise by more than a few hours. Dew is unknown in the summer, at any rate in the plains. During March and April, rainfall tends to be associated with thunderstorms and squalls, Dust-storms often accompany the thunder-storms in 'Iraq, but they may also

occur during most months of the year and their greatest frequency is during the hot weather in June, July and August. In some of the mountain ranges of southern Kurdistan there is sometimes a strong, very gusty N.E. wind known as the " Ghashaba ". In summer it is a dry, rather hot wind raising dust, in winter a dry, bitterly cold wind. The rainfall is low in Central and Southern 'Iraq, averaging less than 150 mm. (6″) per annum. It is also extremely variable. At Baghdad over 17″ of rain were recorded in 1889–90 and only 2″ in 1908–09. On the plains of Northern 'Iraq (the sub-montane area) the rainfall is more than double as much as at Baghdad (330-480 mm. or 13–19″), while in the forest zone of the mountains it is 600–1350 mm. or 24–54″. No records are available for the high mountain zone above the tree level. Very little rain falls in summer (May–October) and rarely any at all during the months of June, July and August even in the mountains. The bulk of the rain falls during the winter months. During this period the mountain passes are blocked with snow, while at the height of winter, frosts are frequent on the plains except in the extreme south east. The months of December and February are slightly milder than January and during March the temperature begins ro rise markedly, continuing its rapid rise in April and May. Even in winter the unsettled weather which accompanies rain is usually of brief duration and occurs at widely spaced intervals, so that on the majority of days the sky is clear and the sun shining. Low cloud is most frequent from November to April, but in Central and Southern 'Iraq the sky is on the average less than half covered with cloud. The amount of cloud is practically negligible from May to October when it rarely exceeds 3/10 of sky covered. During this period the air is extremely dry and the temperature high. By comparison with the days, the nights are cool, for the daily range of temperature at Baghdad from July to September is 30–35°F.

Summarizing the main features of the climate of 'Iraq, there is considerable annual and diurnal variation in temperature. On the one hand there is the hot summer when the percentage of relative humidity is extremely low and dry winds further increase the rate of evaporation. On the other there is the winter when frosts are not uncommon and small falls of rain may be expected. Throughout the year sunshine and a clear sky are more common than cloud. It seems probable that there has been little change in the climate during historical or recent times.

Geology*

'Iraq as a whole has a basin-shaped structure, the oldest rocks outcropping along the border and dipping under successively younger formations towards the centre of the country. The Mesozoic and older Tertiary rocks crop out on each side of the basin, on the west forming a gradually rising limestone country in the Syrian desert and on the east the mountains of Kurdistan and Persia. The main mass of the Kurdish mountains is composed of rock of Mesozoic age, overlaid by thick Tertiary formations. The sequence of formations is as follows :—

Post-Tertiary or Quaternary	Recent		Alluvium and gravel of the present drainage system.
	Pleistocene		Gravel and clay.
		Bakhtiari	Marls, sandstones and conglomerates, the latter increasing upwards.
Kainozoic or Tertiary	Pliocene		
	Miocene	Upper Fars	Red sandstones and marls.
		Lower Fars	Red and green marls, gypsum salt and thin limestone.
	Oligocene	Euphrates and Asmari limestone	Massive limestone, often dolomitic.
	Eocene		Varicoloured shales, sands, and marls and nummulitic limestones.
Mesozoic or Secondary	Cretaceous	Senonian	Globigerinal marls, shales, and limestones.
		Turonian and Cenomanian	Massive dolomitic limestone (Mountain limestone).

The topography of 'Iraq is controlled very closely by the geology of the country. The mountains of southern Kurdistan and the Persian frontier ranges south of the Diyala river are formed of highly folded limestone of Tertiary and Cretaceous age. Westwards in the foothills and submontane region is a zone of thick Upper Fars and Bakhtiari rocks ; in a number of places also Lower Fars is brought to the surface. Jabal Hamrin, the Kifri, Kirkuk and Tauq ranges, Jabal Makhul and the hills of the Mosul plain are due to simple anticlines in which Lower Fars beds have been exposed along the crest and flanks by erosion. The plain of Lower 'Iraq is made up of recent alluvium and the western desert is formed of limestones dipping gently in a north-easterly direction so that the youngest, the Euphrates limestone, crops out along the Euphrates river, the older successively westwards. The great earth movements which determined the present structure came mainly after the deposition of the Bakhtiari gravels. The thrust was due to forces acting from the north-east, and caused the strata to be folded mainly along north-west south-east lines. The mountain ranges of Kurdistan lie in this direction.

A brief description of each of the main formation follows, the principal districts where they are found being mentioned :—

Pre-Cretaceous—Highly bituminous shales and dolomitic limestones. Outcrops of these formations can be seen in patches in the Rowanduz area from Jindian towards the Persian frontier in the direction of Rania.

* (1) Geology of Mesopotamia and its borderlands. 1918.
(2) A. H. Noble ; Subsurface water resources of Iraq. (Baghdad—Government Press. 1927).
(3) Pascoe : Memoirs of the Geological Survey of India. This reference has not been traced.
(4) J. W. Gregory : The structure of Asia. 1929.

Cretaceous—Cenomanian–Turonian massive dolomitic limestone, conveniently termed " mountain limestone ". The higher hills beyond Sulaimaniya and the great massive of Pir-i-Magrun are formed of this limestone. So also in the province of Mosul is the main range behind Amadia. Along the Rowanduz road the Sefin Dagh behind Shaqlawa, the Harir Dagh crossed by the Spilik Pass and the mountains through which Rowanduz Gorge is cut belong to this formation. According to Noble the porosity of this limestone is generally low, but it is so highly jointed and fractured that it would certainly hold and yield large quantities of water. The abundance of large springs which issue where the water table is near the surface is clear evidence that it may be an important water-bearing formation. Before passing on it is worth recording that green serpentine rocks and red cherts have been observed on the Arl Gird Dagh in the Persian frontier zone among highly disturbed rocks of this formation.

Senonian. Mainly globigerinal marls, shales and limestones.

Eocene—The cretaceous limestone is overlaid by varicoloured marls, shales and sands (including red beds in the upper part where nummulitic limestones also occur). This series forms extremely fertile soils, similar to those of the foothills of the Alps and the Carpathian Mountains in Europe. In general they are impervious formations and the bulk of the rainfall flows off them. Springs issue from their contact with the underlying and overlying beds of limestone. They have not been seen in the western desert where the shales of this age are probably replaced by limestone, but they occur fairly frequently in the valleys of Kurdistan. North of Mosul they are found in the valleys between Dohuk and Suwara-Tukka (for example the red banks on which pines grow near Zawita) and beyond in the vale of Amadia. Along the Arbil-Rowanduz road they recur fairly frequently and form the low red hills (capped with a ridge of limestone) behind Shaqlawa and the black shale hills beyond the Khalifan entrance to Rowanduz Gorge. In the Sulaimaniya district they form the rich valley between Bazian Pass and Sulaimaniya and are also seen in the valley between Sulaimaniya and Arbat and elsewhere.

Oligocene and Lower Miocene—The Asmari Limestone, sometimes known as the Euphrates limestone in the region west of the Euphrates. This is a massive limestone, probably dolomitic. Though generally of rather low porosity, it has a certain water-yielding capacity, due partly to jointing. Springs are fairly common along its outcrop. The mountain ranges north of Mosul—the ridges of Zakho, Dohuk, Acra, Zawita and Suwara-Tukka—are formed of this limestone. North of Arbil it forms the dome of the Pirmum Dagh, the small gorge through which the road passes beyond Kora village, the low ridge behind Shaqlawa and the Mirowa Pass. Bazian Pass between Chemchemal and Sulaimaniya also traverses this limestone. West of the Euphrates it forms a broad band which extends out into the Syrian desert ; it also crops out in the Jazira east of the Euphrates.

Miocene—This is divided into two formations, the Lower and Upper Fars.

Lower Fars. This is composed mainly of gypsum or anhydrite with bands of red and green marl and thin limestone ; rock salt is also found

in certain places. It is generally an impervious formation and springs issue from its contact with the Upper Fars above. Other springs actually rise from caverns in the gypsum (e.g. in the Wadi Tharthar near Hatra). Outcrops of Lower Fars can be seen in the Mosul district in the country south-west of the Tigris, in the Jazira, in the Syrian desert west of Ramadi, in the Jabal Makhul and Jabal Hamrin and in the ridges adjoining Kirkuk, Tauq and Kifri. It forms prominent hills which are predominantly white in colour owing to the gypsum. In some parts of the Jazira large flat horizontal crystals of gypsum give the ground the appearance of a frozen floor while in others weathered vertical crystals forms a jagged granular surface.

Upper Fars. This is composed of marl and sandstone, dominantly red in colour. The lower part contains a large proportion of marl with sandstone as a lesser constituent. The upper is predominantly sandstone, but there is a regular alternation of strata. The sandstones have a considerable degree of porosity. They yield a certain number of springs and some shallow wells are dug in them. These sandstones are very uniform in composition. They weather in broad thin slabs and can easily be recognised. The Upper Fars can be seen along the Jabal Hamrin from the Diyala to Injana and north-west to Shargat and Shura, on the south-east slopes of the Kani Dolman hills north of Kirkuk at Baba Gurgur, in the Mosul district north-east of the Tigris and outcropping along the Kurdish foothills, at Khaniq on the Syrian frontier west of the Tigris and at many other places.

Pliocene—This is divided into the Bakhtiari (consisting chiefly of conglomerates, sandstone and marls) and the Post-Bakhtiari gravels and conglomerates. The sandstones predominating in the lower part and the conglomerate and gravel of the upper are good water-bearing strata. The inhabitants of northern 'Iraq have long been accustomed to tap the Bakhtiari gravel by means of " karezes " or underground water conduits by which they obtain water in considerable quantities for the irrigation of their crops and gardens. The Bakhtiari gravels form curious broken ranges of hills which are distinctive and can be easily recognised at a distance. The range of stony hills running north of Kirkuk to the south of Altun Kupri and westwards across the Zab—the Kani Dolman hills and their continuation—form an excellent example. The foothills north-east of Arbil are another.

Pleistocene and Post-Pleistocene—The most recent deposits in 'Iraq consist of gravel, clay and the alluvium of the present drainage system. These formations include the whole of the area south of the Jabal Hamrin (a belt bounded on the west by a line running south to Felluja and thence roughly following the Euphrates and on the east by the line of the Persian foothills) and various parts of the area north of the Jabal Hamrin, such as the rich plain of Arbil between the two Zab rivers, the plain of Kirkuk and other places.

Soils

Few investigations have been carried out on the soils of 'Iraq and there is little published information available, with the exception of one or two

studies on the soils of Lower Iraq.* The alluvial soil of this area is mainly a fertile calcareous loam with sandy patches here and there and with some saline tracts, found chiefly either in the depressions where salt has accumulated by the evaporation of successive river floods or on the site of ancient abandoned cultivated areas where constant irrigation and lack of drainge caused a toxic accumulation of salts. A characteristic of the soils of Lower 'Iraq—and indeed of the majority of soils in the country—is that they are extremely rich in lime, brought down from the limestone hills in the form of light calcareous silt. A series of some thirty analyses of soils from the area between Baghdad and Daltawa, bounded to the east by the Diyala River and to the west by the Tigris, showed that the lime content of the soil varied in this region from about 12% to 25% ; in some of the samples it was even greater. The mean content of Phosphoric acid in the soil worked out at about 0·18%, of Potash at above 0·4% and of Nitrogen as considerably below 0·1%. The proportion of the first two of these plant foods is relatively high, but the nitrogenous content is decidedly low. About 50% of the soils were found to be soluble in Hydrochoric Acid and consisted largely of Calcium and Magnesium Carbonates. The percentage of water-soluble salts varied from about ·05–1·5%, the percentage in the great majority being below 0·1%. These soluble salts consisted of Calcium Carbonate and Sulphates and Chlorides of Calcium, Magnesium and Sodium ; the quantities present were generally rather below the point at which a definitely harmful effect on crops is exercised.

Sodium Carbonate or black alkali has not been found in 'Iraq. Some analyses of salt lands in the country have, however, shown over 5% of soluble salts present in the soil ; this is, of course, in excess of the amount which crops, or indeed most plants, will tolerate. With the exception of such saline stretches the soil of the whole alluvial plain of Lower 'Iraq is comparatively uniform, varying naturally from place to place in texture and fertility but belonging essentially to the same general type—a silty calcareous loam.

Outside the alluvial plain there are a good many different types of soil, but unfortunately no survey has been carried out nor has the composition of any of these soils been determined with the exception of some recent analyses of a few soils from Kurdistan which are mentioned below. It is therefore impossible to treat them in an orderly sequence or to make more than a casual mention of one or two of the commoner types. A soil rich in gypsum is found over wide stretches in 'Iraq, such as in the Ghurfa plain (north of Daltawa) and in many parts of the Jazira, the desert lying in the triangle between the two rivers, Tigris and Euphrates, and Jabal Sinjar. In other parts of the Jazira the soil is composed of gravel or marl with broad sandy stretches. A type found over large regions in the Syrian desert is a hard compact soil with small pebbles or large stones scattered over its surface. In parts of this area

* J. F. Webster—"Alkali lands in Iraq." Dep. Agr. (Iraq) Mem. No. 1 (Bombay 1921).
J. F. Webster & B. Viswanath—"Report on the Soil Survey of the Diyala area." Dep. Agr. (Iraq) Mem. No. 2 (Bombay 1921).
J. F. Webster & B. Viswanath—"Further studies of Alkali Soils in Iraq." Dep. Agr. ('Iraq) Mem. No. 5 (Bombay 1921).
Sir W. Wilcocks—"The Irrigation of Mesopotamia." 1911.

the soil composition varies to a coarse sandy or fine pebbly texture. Thin deposits of sand (3–4″ thick) are sometimes found spread over the soil plain ; these are not very common. Throughout the whole length of the route between Baghdad and Damascus no sand dunes are encountered. Small dune areas occur, however, in other localities, though there is nothing comparable to what is found in the deserts of north Africa. On the plains of the sub-montane area some very heavy soils are encountered, such as the stiff red soil of the Arbil plain ; this soil contains relatively little gypsum and is much more fertile than some of the Kirkuk soils which are similar in other respects. In the Bakhtiari foothills the predominant soil is gravel, while heavy marls are often found in the valleys of Kurdistan.

Recently some twenty samples obtained from Kurdistan have been examined by the Imperial Institute*. These samples were all collected in the area round Zawita village (east of Dohuk). Five representative types of soil and two rock specimens were selected for analysis. The two rock samples proved to be a granular dolomite and an impure siliceous and ferruginous dolomite, the silica in the latter being mainly present in the opalescent form. Magnesium Carbonate was found in all the soils. Some of them contained a large amount of organic matter, particularly those occupied by Pinetum. One of these soils is described as an impure disintegrated limestone ; it is a common type in places where dense pine forest is growing among boulders on steep rocky slopes. The soils were all faintly alkaline in reaction (varying from 7·3–7·5 p.H.) and did not contain large amounts of soluble salts. With the exception of one sample obtained from a place where the plant cover was exceptionally small all the soils were fairly heavy, consisting largely of silt and clay fractions. The exception was a very sandy reddish soil which came from rather beyond the Zawita area. This soil supported little vegetation except some scattered tufted mats of thyme, the greater part of its surface being completely bare. The examination of the rock samples showed that the soils are derived from a dolomite rock of varying composition, that is to say the Tertiary limestone which forms the main ridge of the Zawita horse-shoe. As this rock crops out in many other parts of Kurdistan it is probable that similar soils occur over large areas in the mountains, although the pine forests which characterise Zawita itself are only found in one other locality in 'Iraq, namely at Atrush some miles to the east of the Zawita valley.

Ecology

The plants of 'Iraq belong mainly to the flora of the Orient (i.e. the area more or less covered by Boissier's " Flora Orientalis ") which is the phyto-geographical region, termed Irano-Touranian, suggested by Eig.* This is the region included by Boissier under the Orient proper and subdivided into (1) the sub-region of plateaux, (2) the Aralo-Caspian subregion and (3) the Mesopotamian sub-region (or, as suggested by Eig.

* The writer wishes to acknowledge his indebtedness to the Imperial Institute for carrying out this examination. The above description is summarised from the report on the samples.

* A. Eig : " Les éléments et les groupes phytogéographiques auxiliaires dans la flore Palestinienne." Fedde Repert. Spec. Nov. Reg. Veget. Band **63,** I Texta, 1–201, II Tableaux analytiques 1–120 (1931–2).

(1) the Iranian, (2) the Touranian and (3) the Mesopotamian domains). The wealth of species in this region is great, but the flora as a whole is still insufficiently known to admit of a revision of these sub-divisions. Its exact limits are still ill-defined, but broadly-speaking it includes the eastern parts of Syria, Palestine and Transjordiania and stretches across 'Iraq and Persia to Afghanistan and Baluchistan, including also the Armenian plateau and the plains of Turkistan. It is bounded on the west by the Mediterranean region, on the south by the Sahara-Sindian, on the east by the Sino-Japanese and on the north by the Eurosiberian–Boreo–american regions. As far as 'Iraq is concerned the two latter need not be considered, but there are penetrations and outliers (" enclaves ") of the vegetation of the Mediterranean and Saharo-Sindian regions within the Irano-Touranian vegetation of 'Iraq ; in other places the vegetation is transitional between the types common to each of these regions and the Irano-Touranian.

In his paper Eig summarized the main characteristics of the Irano-Touranian region somewhat as follows :

1. The extreme diversity of the configuration of the land—of the physical-geography of the area. It includes high plateaux at different levels, low plains and mountain chains running in every direction. At first sight nothing seems to unite these areas with such geographical contrasts into a natural region.

2. The uniformity of the climate in its essential features over the whole area. It is this which brings the area into the category of a single natural climatic region. The main characteristics of the climate are :—

(a) Low rainfall and a completely rainless season (but the deserts are of limited extent compared to those of the Saharo-Sindian region).

(b) Extremely wide oscillations of temperature. The high temperatures of summer often equal those of the Sahara while the winter is generally severe, much more severe than one would expect in such latitudes. The severity of the winter is naturally more marked with a rise in altitude ; but, in general, the low temperatures are much below those of the Mediterranean and Saharo-Sindian regions. The daily range of temperature is also considerable.

(c) The existence of two distinct periods in the year when plant-growth is arrested—the summer period due to extreme heat and dryness (see p. 388), the winter period due to the rigours of snow or cold.

3. The characteristic flora and vegetation. The area is covered by an essentially steppe vegetation, dominated by hemi-cryptophytes (chiefly grasses) and chamaephytes (chiefly dwarf shrubs) forming more or less dense groups or (particularly in saline deserts) open groups. Other features if this vegetation are :—

(a) The almost complete absence of forest climaxes or even of climaxes of large shrubs (except in the mountains, as outliers (" enclaves ") of other regions, such as the Mediterranean).

(b) The enormous development of certain systematic groups, *Astragalus* (with its 900-950 spp.), *Cousinia* (with 160–180 spp.), *Centaurea* (with some 200 spp.), *Salvia* (with over 100 spp.), *Allium*, *Acantholimon*, etc.

(c) The total number of species found in this region is high.

(d) The number of endemic species is also considerable.

(e) The pronounced specialization of the systematic groups above species. The number of endemic genera is something like 200. The *Astragalinae*, *Polygonoideae*, *Atraphaxidae*, *Suaedeae*, *Salsolaceae*, *Cynareae*, *Echinopsidineae*, etc., are higher systematic groups which have their centre of dispersion in this region.

(f) The family, *Chenopodiaceae* is generally well-represented in this region.

(g) Shrubby *Chenopodiaceae* (*Haloxylon*, etc.) and gum-bearing shrubs (*Acantholimon*, *Astragalus*, etc.) are characteristic of this region. The latter are particularly numerous on the high plateaux and in the mountains.

The main characteristics of the Mediterranean region are sufficiently well known. Hot dry summers and mild wet winters are the essential features of the Mediterranean climate and the plant associations which belong to it are mainly sclerophyllous or coniferous forests and xerophytic shrub associations. A wealth of endemic species and genera are found in this region and one cultivated plant, the olive, seems admirably adapted to its ecological conditions, which are extremely uniform. The older writers used the term Mediterranean to cover part of the Irano-Touranian region. This is discussed in detail by Eig. He does not deny the real similarity between the floras of the two regions, but does not consider it sufficient to justify coupling them together, since the greatest similarity is found in the mountains of the Irano-Touranian region which can more or less be considered as Mediterranean outliers (" enclaves ").

Some of the characterisics of the Saharo-Sindian region mentioned by Eig are the extreme dryness of the air, the high temperature (even the minima seldom go below zero), the low rainfall and the salinity of the soil. The vegetation of this region is extremely monotonous ; the same type or even the same single species may cover immense areas. Poverty in the number of species and extreme poverty in the number of individuals (i.e. low soil covering) are also characteristic of the region, and the proportion of the systematic groups to the species is poorly developed. A cultivated plant, the date, is found throughout the Saharo-Sindian region, though this being a plant of the oases cannot be considered as truly characteristic. This region stretches from the Atlantic in Morocco to the deserts of Sind and Southern Afghanistan.

Lying as it does on the south-west edge of the Irano-Touranian region one would expect some of the vegetation of 'Iraq to be of a transitional type and to show affinities with the vegetation of the neighbouring regions. To map out the vegetation of 'Iraq accurately and to show exactly where the demarcations come will require long and detailed study. Only certain broad generalizations can be made at present. Thus, in the desert south-west of Zubair (near Basra) the vegetation was found to be

of an entirely different type from that of the Syrian desert further north. Over the greater part of the Syrian desert between Damascus and Ramadi (on the Euphrates) there are associations of *Artemisia herba-alba*, *Haloxylon* sp. with *Poa bulbosa* and the plant covering of the soil is generally high (80–90% or even higher). The extent of plant cover in the Zubair desert was not more than 50-60% and *Poa bulbosa* was absent altogether. Instead of an even steppe-like covering, the plants were much more openly spaced, the conditions approximating more to those of a true desert than those of a steppe. Unfortunately, the only visit to this area was during the course of a journey which allowed no time for a detailed study of the vegetation, and there was no second opportunity of visiting the locality. The dominant plant here was a shrubby composite, *Rhanterium epapposum*, called by the Arabs " ARFAJ ". At scattered intervals were low sandy mounds collected round plants of *Citrullus colocynthis*, *Hyparrhenia hirta*, and *Convolvulus oxyphyllus* with small colonies of annuals such as *Hippocrepis bicontorta*, *Medicago laciniata* and *Astragalus annularis* clustered about them. Other plants in these desert associations were *Emex spinosus*, *Neurada procumbens*, *Scrophularia deserti*, *Helianthemum lippii*, *Asphodelus tenuifolius*, *Arnebia decumbens* and *Gastrocotyle hispida*. This area is near the southern frontier of 'Iraq, bordering on the great desert plateau of Arabia. The type of vegetation here and the poverty of the individual plant assemblages, are more characteristic of the Saharo-Sindian region than at any other placed visited in 'Iraq. In the north the mountain areas of Kurdistan with their forests of *Quercus* spp., *Pinus halepensis*, var. *brutia*, etc., support a vegetation which is largely of a Mediterannean type.

Handel-Mazetti*, whose studies covered part of the territory which is now 'Iraq, divides the area into Kurdistan (the mountains) and Mesopotamia (the plains) ; he further sub-divides the plains into the deserts of southern Mesopotamia and the steppes of northern Mesopotamia. He discusses the implication of these words, desert and steppe, and gives a definition of each. He defines a steppe as uniformly distributed, open, treeless vegetation, dry in summer yet still visible throughout the summer during which time it can be pastured, while he defines desert vegetation as that which often appears in spring luxuriantly and uniformly distributed, but which disappears completely during the summer or survives very sparsely in special and well-defined localities or produces reduced perennials and then provides no more pasture. On the basis of this distinction he divides the desert vegetation of southern Mesopotamia by a line running approximately along the 35th parallel of latitude at an elevation of about 450 ft., passing through such places as Dor-az-Zair on the Euphrates and Tekrit on the Tigris. He subdivides each of these two main divisions into a number of edpaphic types such as sand desert, gravel desert, gravel steppe, humus steppe, gypsum steppe, etc.

It is somewhat doubtful how far Handel-Mazetti's division of 'Iraq into desert and steppe can be sustained on a modern ecological basis. It is true that owing to the higher rainfall in the neighbourhood of the mountains the vegetation of the sub-montane plains is less scanty and

* Handel-Mazetti, M. F. von—" Wissenschaftliche Ergebnisse der Expedition nach Mesopotamien 1910 " Annalen des K. K. Natur-historischen Hofmuseums, Wien, 1912–14.

more persistent in summer than that of the lower alluvial plain and of the Syrian desert. But if the northern plains are to be regarded as steppes it is doubtful whether any abrupt change to truly desert conditions occurs until much further south when the distinctions which were noted in the vegetation of the Zubair desert begins to be apparent. Handel-Mazetti gives lists of plants found on each of the edaphic formations he describes, but does not mention the quantitative composition of the plant associations at all.

Most of the observations here recorded were made during brief halts while travelling from place to place. It was not often possible to find an opportunity of returning to an interesting locality so as to conclude a more detailed study of it. Most of the routes in Lower 'Iraq pass through cultivated regions—or regions which were formerly cultivated—in the neighbourhood of rivers, canals and human habitations. Here the conditions are quite unnatural and the original vegetation has frequently been replaced by secondary associations. Out in the open country tracks may be poorly marked or absent altogether while drinking water and human habitations are usually lacking for immense distances. To visit such areas it is necessary to take a Badouin guide and to be accompanied by a second car carrying a reserve of water and provisions. Although one or two short expeditions were arranged to such places as the Jazira many parts of 'Iraq have not been visited at all, while only the fringe of others has been studied. Thus it is premature as yet to attempt a comprehensive picture of the vegetation of the country or to map out its ecological divisions. All that is attempted here is to describe briefly some of the more general associations.

The vegetation of the river banks, canals, marshes and ponds of Lower 'Iraq

The banks of the Shatt-al-Arab from the Persian Gulf to Basra and above are lined with date plam gardens (*Phoenix dactylifera*) extending for an average width of a mile inland and intersected by creeks running up from the river. Up to Qurna the river is tidal and, though the rise and fall is not large, a certain expanse of mud is daily exposed or covered by shallow water. Date gardens are planted along the river banks in many localities as far north as Samara on the Tigris and Ana on the Euphrates. Groves of *Salix acmophylla* are found at certain places, for example on the Euphrates at Babylon (near Hilla). *Populus euphratica*, often infested by *Cuscuta lehmanniana*, forms riverside thickets on the Diyala at Baquba and on the Tigris at Baghdad and elsewhere ; it does not appear to be found so far south as Basra, where the Arabic name " gharab " used for it at Baghdad is used for *Salix*. *Tamarix pentandra* var. *tigrensis* and *T. meyeri* are also commonly found in riverside thickets. During the summer, as the water recedes, the inner river banks become covered by *Glinus lotoides*, while down by the water's edge the exposed flats are occupied by an association of *Cyperus pygmaeus* and *Fimbrystilis dichotoma* with *Crypsis alopecuroides* and other grasses. The southern marshes are immense shallow inland lakes or broads where numerous small banks and mud flats are exposed when the water is low. Dense associations of *Phragmites communis* and *Typha angustata* occupy many square miles in these marshes. In the late autumn the shallows above the mud flats are pink with the flowers of *Polygonum salicifolium*. The surface of the water

is often covered by floating colonies of *Salvinia natans* and *Nymphoides indicum*, while *Ceratophyllum demersum* can be seen in the water below. An association of aquatic *Ranunculus* often occupies the surface of ponds or small creeks which have been dammed off from the stream. *Cyperus rotundus* and *Lippia nodiflora* are frequently found in wet places by canals and ditches.

The vegetation of the plains of Lower 'Iraq and the Syrian desert

Large tracts of the alluvial plain of Lower 'Iraq—and especially the greater part of the land bordering the rivers or traversed by modern canal systems—are under cultivation. Other large tracts which are now desolate were once cultivated, though now only the dry ribs of ancient canals or the small mounds representing village sites denote that these regions were once peopled. The vegetation of the whole of this area has been much influenced by mankind—by irrigation, tillage and pasturage, and by the frequent cutting and removal of the woody perennial plants for fuel. The result is that much of the vegetation is secondary and even in long abandoned areas can only be looked upon as semi-natural. An excellent example of such vegetation is a pastoral association found covering large areas of plain between Baghdad and Felluja, east of Ctesiphon (near the junction of the Diyala and Tigris below Baghdad) and elsewhere. This consists principally of *Matricaria aurea*, and *Erodium cicutarium* with *Leontodon hispidulum*, *Plantago coronopus* (and other spp.), *Koeleria phleoides*, *Astragalus* sp., etc. as associated plants. Large flocks of sheep are seen grazing on this association in spring. Along the rivers uncultivated land is generally covered by fairly dense associations of *Prosopis farcta*, *Alhagi maurorum* (more developed on slightly more saline soils) and *Glycyrrhiza glabra* (especially in the neighbourhood of the river or of large canals). The people are continually digging up the roots of *Glycyrrhiza* for sale and export to the liquorice trade. *Prosopis farcta* is the plant most commonly cut for firewood, so in these inhabited regions it is seldom allowed to grow more than 1 ft. to 2 ft. high before it is cut to the ground ; but in one or two places on the Tigris small almost impenetrable thorny thickets of this plant are found, where the shrubs have developed dense woody growth and attained a height of 5 ft. to 6 ft. *Prosopis farcta* is a plant with exceedingly long roots which penetrate to the subsoil water where the water table is high near the river banks.

Out in the open country away from the inhabited areas bordering the rivers, associations of *Haloxylon salicornicum*, another *Chenopod* and *Artemisia herba-alba* are most common. One or other of these associations is found at almost every point along the route across the Syrian desert from Ramadi to Damascus, a distance of nearly 500 miles. These perennial plants do not attain their full development till the summer and autumn when the annual plants have dried up ; they may then cover anything up to a quarter of the surface of the ground. In the spring dense associations of *Poa bulbosa* and *Carex stenophylla* with annuals such as *Plantago ovata*, etc. cover the ground between the bare sticks of the perennial bushes and may form a herbage several inches high if the winter rains have been sufficient. *Poa bulbosa* is by far the commonest plant in these natural associations and frequently occupies $\frac{1}{2}$ to $\frac{3}{4}$ of the surface of the

ground or even more. Associated with it in addition to the above are such plants as *Astragulus* sp., *Arnebia decumbens*, *Helianthemum salicifolium*, *Senecio coronopifolius*, *Matthiola oxyceras*, *Koelpinia linearis*, *Koeleria phleoides*, *Gagea reticulata*, *Matricaria aurea*, *Gymnarrhenia micrantha*, *Aizoon hispanicum* and many more. Another association found over large areas—for example in the Ghurfa plain north of Daltawa or in the plain of Khanaqin, where thousands of sheep are pastured by the Badouin in spring—consists of *Stipa tortilis* and *Poa bulbosa* with *Leontodon hispidulum*, *Erodium cicutarium*, *Filago spathulata*, *Malcolmia torulosa*, *Koeleria phleoides*, *Astragulus* sp., *Ceratocephalus falcatus*, *Matricaria aurea*, etc. On salt lands associations of *Arthrocnemum* (probably *A. glaucum*), *Suaeda vermiculata*, *Atriplex tataricum* (?) and *Tamarix passerinoides* (*T. macrocarpa*) are found ; *Statice spicata* and *Spergularia diandra* are frequent components of these halophytic associations. An exceedingly common plant found chiefly along roads and tracks, by desert camping grounds, near villages and by human habitations is *Peganum harmala*. *Lycium barbarum* and *Capparis spinosa* are two common shrubs in this area. *Capparis spinosa* sometimes leads to the formation of hummocks owing to the soil which collects round the base of each bush. In these open associations of *Capparis* it is interesting to note the presence of a subsidiary association of small annuals and perennials growing on the hummock at the base of each caper bush. The desert association found near the southern frontier of 'Iraq beyond Zubair has already been mentioned.

The vegetation of the sub-montane area

As one proceeds norhwards in the direction of the mountains the winter season besides beng rather longer becomes colder ; the rainfall increases considerably, but the summers, though a little shorter than in Lower 'Iraq, are otherwise much the same. In these regions the spring vegetation is more luxuriant and less monotonous than in the south ; the summer perennials are more numerous. Both in spring and in early summer many gaily-coloured flowers are in bloom. A much larger proportion of the land is cultivated in this area, almost the whole of the plain of Arbil being divided into cultivated fields, as well as a large part of the plains of Mosul and Kirkuk. Strips of natural vegetation are, however, found throughout the region and quite large areas are uncultivated in the country running up towards the Syrian border to the north-west of Mosul. One of the two commonest natural associations on these northern plains consists chiefly of *Phlomis bruguieri*, *Phlomis kurdica*, *Cousinia stenocephala*, *Poa bulbosa*, *Carex stenophylla* and *Ranunculus asiaticus*. In spring the last three (*Poa*, *Carex* and *Ranunculus asiaticus*) with many associated annual and small perennial plants form a close green herbage on which the crimson flowers of the *Ranunculus* are dotted, often giving the landscape a reddish appearance. Later after these small plants have withered away and begun to expose the bare earth, clumps of *Phlomis* and *Cousinia* come into flower. Many other plants are associated with the above at one place or another. Some of the commoner are *Gundelia tournefortii*, *Teucrium polium*, *Prosopis farcta*, *Artemisia herba-alba*, *Salvia palaestina*, *Hypericum triquetrifolium*, *Eminium intortum*, *Ornithogalum iraqense*, *Oliveria decumbens*, *Koeleria phleoides*, *Helianthemum salicifolium*, *Helianthemum aegyptiacum*, *Plantago psyllium*, *Plantago*

bellardi, *Adonis sp.*, *Minuartia picta*, *Erodium cicutarium*, *Androsace maxima*, *Filago spathulata*, etc., etc. An association which has been seen a good many places west and north-west of Mosul consists principally of *Centaurea behen*, a broad-leaved herb several feet high the roots of which are much used by the people for fuel. Associations of this plant sometimes grow so densely that the land occupied by it has somewhat the appearance of an immense cabbage patch. *Centaurea behen* is often associated with *Phlomis bruguieri*, *Prosopis farcta*, *Cousinia stenocephala*, etc. Another association found in some localities on the northern plains or in the lower foothills includes many of the plants already mentioned (*Phlomis*, *Cousinia*, *Prosopis*, *Gundelia*, *Poa*, *Carex*, *Ranunculus asiaticus*, *Ranunculus millefolius*, etc.) with in addition *Vinca libanotica*, *Thymus* sp., *Gentiana olivieri*, *Geranium tuberosum*, and other plants. An association of *Asphodelus aestivus* is frequently found in small valleys and open depressions in the neighbourhood of the foothills. The asphodel clumps are sometimes so dense that they occupy as much as three-quarters of the total land surface. The intervening spaces are occupied by an association of *Poa bulbosa*, *Carex stenophylla* and *Ranunculus asiaticus* with *Phlomis*, *Gundelia*, *Ornithogalum*, *Gagea* and other plants. The gravel hills of the Bakhtiari formation support an association in which the dominant plants are two dwarf shrubs, *Astragalus gossypinus* and *Astragalus russelii* ; these two species may cover a quarter to half the total surface of the ground. Associated with them are a variety of plants, including *Salvia palaestina*, *Anchusa italica* var. *kurdica*, *Thymus syriacus*, *Stipa tortilis*, *Linum mucronatum*, *Gypsophila* sp., with *Phlomis brugieri*, *Cousinia stenocephala*, *Teucrium polium*, *Poa bulbosa* and many of the plants already mentioned. This association can be seen in the Kani Dolman hills between Kirkuk and Altun Kopri or along the Rowanduz road at Khanzad Pass near Arbil. Another association which occurs in one or two localities in the area between Dohuk and Zakho is dominated by the shrub *Anagyris foetida*.

The vegetation of the Kurdish mountains

(a) *The mountain streams and ditches*. Small ditches and slow marshy streams in the lower mountain valleys are sometimes completely filled by an association of *Poa persica* with *Veronica beccabunga*. Other plants growing in or near such places are *Nasturtium officinale*, *Typha angustata*, *Lythrum salicaria*, *Ranunculus sericeus*, *Mentha longifolia*, *Rubus sanctus*, etc. Larger streams are often bounded by a narrow strip of *Phragmites communis* growing along the edge of the water. Common on their banks are *Salix purpurea*, *Salix aegyptiaca*, *Platanus orientalis*, *Fraxinus* spp., *Vitis vinifera*, *Rubus sanctus*, *Cynanchum acutum*, *Eupatoria cannabinum*, *Pulicaria dysenterica* and *Saccharum ravennae*. Further from the edge comes *Nerium oleander* and furthest *Vitex agnus-castus* and *Paliurus spina-Christi*. *Nerium oleander* is also found in the foothill region and *Vitex agnus-castus* along the banks and hummocks of the stony torrent beds of the sub-plains. *Adiantum capillus-veneris* is common below dripping rocks and cliffs by streams ; it is also found in wells in Lower 'Iraq.

(b) *The forest zone*. The Kurdish mountains between the altitudes of 2000–6000 ft. are mostly covered by more or less open oak forest. In many places owing to continual cutting by men and subsequently cropping by goats the oak forest has been destroyed and the trees remain

stunted, forming low scrub ; in other places away from villages the trees attain a considerable size. The commonest species are *Quercus aegilops* subsp. *brantii* and *Quercus infectoria*. Associated with them are *Acer cinerascens*, *Pistacia mutica*, *Pistacia khinjuk*, *Crataegus monogyna*, *Crataegus heterophylla*, *Crataegus azarolus*, *Pyrus syriaca*, *Juniperus oxycedrus*, *Prunus divaricata*, *Cotoneaster nummularia* and *Anagyris foetida*. The ground vegetation is varied and includes such plants as *Euphorbia tinctoria*, *Echinops viscosus*, *Teucrium polium*, *Phlomis kurdica*, *Gentiana olivieri*, *Gundelia tournefortii*, *Xeranthemum squarrosum*, *Centaurea virgata*, *Carthamus flavescens*, *Caucalis leptophylla*, *Turgenia latifolia*, *Poa bulbosa*, *Hordeum bulbosum*, *Thlaspi perfoliatum*, *Anemone coronaria*, *Geranium tuberosum*, *Ranunculus millefolius* and many others. In two regions small pine forests are found, namely at Zawita and Atrush (about 25 miles north of Mosul in the mountains to the East of Dohuk). The range of altitude, of these pine forests is about 2500–4000 feet. The species of pine is a variety of *Pinus halepensis* and it is usually associated with some of the trees found in the oak forests (*Quercus*, *Juniperus*, *Pistacia* sp.) On the limestone crags of the Zawita ridge where part of the pine forest is situated *Wendlandia ligustroides*, *Fumana arabica*, *Asparagus verticillata*, *Ferulago angulata*, *Hypericum scabrum*, *Thymbra spicata* and *Sideritis kurdica* are also found.

c) *The high mountain zones*. I was only able to visit the higher mountain regions of Kurdistan (above 6000 ft.) on one occasion. This region has hitherto been rather inaccessible but the pacification of the Kurdish tribes and the recent opening of the Arbil-Rowanduz road have brought many of the mountains of the area within easy reach of the traveller. The following brief description is based on observations made during an expedition to the Arl Gird Dagh which lies on the Persian frontier to the N.E. of Rowanduz. The summit of this mountain, the highest point in 'Iraq, lies at 12,200 ft. above sea level and the main ridge of Chia-i-Mandali, which was also climbed, is over 9,000 ft. high. In this area and also in the region of Amadia the upper limit of the forest appears to be 5000–6000 ft. above sea level. Above it there is often a narrow zone of a shrub formation of *Daphne acuminata* with *Euphorbia tinctoria*, *Echinops* sp. and other plants. The next zone which extends upwards to an altitude of about 7000 ft. is what Handel-Mazetti terms the thorn-cushion zone ("dornpolsterstrafe"). The dominant plants of this formation are low spiny herbs and dwarf shrubs which grow in the form of compact cushions, often measuring several feet across. The habit of these plants is extremely xerophytic and the leaf surface is much reduced ; often the leaves are modified into spines, the whole plant being compact, dense and well-protected against rapid transpiration. The principal components of this zone are species of *Astragalus* and *Acantholimon*, many of which had not reached their full development and could not be identified. Of those which were in flower and could be recognized *Astragalus kurdicus*, *Astragalus carduchorum*, and *Acanthophyllum crassifolium* were the commonest. On the higher rocky mountain slopes herbs which are often highly aromatic predominate. Among the plants recorded at these altitudes (above 8000 ft.) are *Anchonium elychrysifolium*, *Alyssum lanigerum*, *Arabis caucasica*, *Helichrysum pallasii*, *Helichrysum plicatum*, *Pyrethrum kotschyi*, *Pyrethrum millefoliatum*, *Pyrethrum myriophyllum*, *Artemisia splendens*, *Physoptychis gnaphalodes*, *Scutellaria pinnatifida*, *Silene subulata*, *Silene odontopetala*,

Lepyrodiclis paniculata, *Onobrychis cornuta*, *Cerasus brachypetala* var. *bornmuelleri*, *Achillea vermicularis*, *Erigeron amorphoglossum*, *Galium kurdicum*, *Asperula prostrata*, *Thymus kotschyanus*, *Phlomis rigida*, *Stachys lavandulifolia*, *Nepeta ludlow-hewittii*, *Lamium tomentosum*, etc., etc. A dense association of *Vicia gregaria* is common the damper parts of the mountain sides especially in the shallow gulleys. On the Arl Gird Dagh *Myosotis alpestris* is found in dense blue clumps on the narrow ledges just below the summit of the mountain (alt. 11,000-12,000 ft.). The small lakes near the top of this mountain (alt. 10,000 ft.) are bordered by damp turf covered with *Ranunculus brachylobus*. *Primula auriculata* also grows in these places.

The common weeds and the cultivated areas

Many of the plants which have already been mentioned are found in cultivated places as well as in natural associations. Other plants are only found as weeds of cultivation or occur as weeds in one part of the country, but in natural associations in another.

Probably the commonest weeds in cereal fields throughout 'Iraq are wild oats (*Avena fatua* and *A. sterilis*) which sometimes exceed 50% of the total ground vegetation of the crop. Other common weeds in winter cereal fields are *Melilotus indicus*, *Anagallis arvensis*, *Malva nicaeensis*, *M. parviflora*, *Lepidium draba*, *Centaurea iberica*, *Calendula persica*, *Diplotaxis erucoides*, *Erodium cicutarium*, *Medicago hispida*, *Saponaria vaccaria*, *Fumaria bracteosa*, *Lathyrus sativus*, *Vicia sativa* and other spp., *Phalaris brachystachys*, *Agropyrum buonapartis*, *Alopecurus myosuroides*, etc. Often after harvest thistly plants develop, especially in the neighbourhood of the irrigation channels ; these include *Centaurea phyllocephala*, *C. iberica*, *C. pallescens*, *Carthamus oxyacantha* and *Eryngium creticum*. Among summer crops some common weeds are *Dicanthium annulatum*, *Eragrostis cilianensis*, *Sorghum halepense*, *Heliotropium europaeum* var. *tenuiflorum*, *Haplophyllum propinquum*, *Crozophora verbascifolia*, *Cressa cretica*, *Polygonum argyrocoleon*, *P. aviculare*, *Scorpiurus sulcata*, *Francoeuria crispa*, *Pulicaria arabica*, *Ammi majus*, *A. visnaga*, *Convolvulus arvensis* and *C. pilosellifolius*.

Passing northwards towards the sub-montane area the spring weeds in the cultivated areas become more conspicuous and more numerous. Many bulbous plants are found, among them *Gladiolus segetum*, *G. atroviolaceus*, *Bellevalia kurdestanica* and possibly other species, *Muscari longipes*, *Ixiolirion montanum*, *Tulipa stapfii*, *Ornithogalum narbonense* and other spp. and several species of *Allium* (*A. akaka*). Other conspicuous plants in the fields of the sub-montane plains are *Salvia spinosa*, *S. syriaca*, *Hyoscyamus reticulatus*, *Anchusa italica*, *A. italica* var. *kurdica*, *Malabaila aucheri*, *Reseda lutea*, *R. decursiva*, *Convolvulus stachydifolius*, *Achillea aleppica*, *A. micrantha*, *Sterigmostemum sulphureum*, *Leontice leontopetalum*, *Bongardia chrysogonum*, *Scrophularia xanthoglossa*, *Onosma dichroanthum*, *Malcolmia crenulata*, *Matthiola oxyceras*, *Isatis aleppica*, *Texiera glastifolia*, *Adonis persica*, *Glaucium corniculatum*, *Trigonella coelesyriaca*, *Valerianella* spp., *Iberis odorata*, and *Silene conoidea*.

Electricity in the Garden.*—In view of the increasing use of electricity in horticulture, this little book will be found useful to all those interested in the subject. The author, who is qualified in electrical engineering, devotes the opening chapters to the fundamentals, the electric motor, and garden installations. He then goes on to deal, among other things, with such matters as soil warming, electrically heated hotbeds, electric heating in greenhouses and soil sterilization. Extracts from "The British Standard Draft Code of Practice Farm and Horticultural Installations (1949)" are given in the Appendix, followed by a short bibliography and an index. The book is well illustrated with 23 photographs and 27 line drawings.

H. S. Marshall.

Perpetual Flowering Carnations.†—The author of this book has had thirty years' experience in growing perpetual flowering carnations, and deals with the cultivation of these popular flowers from all aspects.

Considering the size of the book much useful information is provided. There are ten chapters dealing with greenhouses and heating methods, propagation by cuttings, culture in pots and beds, soilless culture, stopping, selection of varieties, raising new varieties, and pests and diseases. The book is ilustrated by photographs and line drawings, and forms a reliable guide to those who contemplate the cultivation of this valuable and attractive race of carnations.

H. S. Marshall.

Seeds.‡—The problems of germination are of both scientific interest and practical importance, and one therefore welcomes this collective account of the work which has been carried out very largely by the authors themselves at the Boyce Thompson Institute. The investigations elsewhere are not so adequately covered, and this no doubt is responsible for the rather cursory treatment of some aspects, as, for example, the influence of light which has been the subject of numerous investigations, but is here dealt with in a page and a half. If, however, as survey of the subject as a whole, this work leaves something to be desired, it constitutes a useful summary of much that is known in this field, and which is widely scattered through periodical literature.

E.J.S.

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* Electricity in the Garden. By Geoffrey Gerard. Pp. x + 125, 23 photographs and 27 line drawings. London : W. H. & L. Collingridge Ltd. 1953. Price 15/-.

† Perpetual Flowering Carnations. By R. J. Morton. Pp. 79, 28 photographic plates and 9 line drawings. London : W. H. & L. Collingridge Ltd. 1953. Price 10/6d.

‡ Physiology of Seeds by W. Crocker & L. V. Barton (Boyce Thompson Institute, Yonkers, N.Y.). The Chronica Botanica Co., Waltham, Mass., U.S.A. Wm. Dawson & Sons, Ltd., London, W.C.2. Price $6.50.

THE GENUS ENSETE IN AFRICA

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I. *Introduction*

The genus *Ensete* was proposed by Horaninow in 1862 but received no general recognition until revived by E. E. Cheesman (Kew Bull. **1947**, 97) who pointed out that its members differed sharply from the true bananas in being mainly African in distribution, in being monocarpic, in having a basic number of 9 haploid chromosomes and in their large seed size. We visited East Africa in 1948 and made numerous collections in Kenya, Uganda and Tanganyika. Upon the basis of these specimens and of re-examination of types and other collections at the Royal Botanic Gardens, Kew, at the British Museum and at the Herbarium of the State Botanic Garden, Brussels, this revision of the African members of the genus has been prepared. We wish to thank the Directors and staffs of these herbaria for their kindly help ; and the Director of the Paris Herbarium for the loan of the types of *Musa chevalieri*. We wish to acknowledge particularly the help of Mr. E. Milne-Redhead of the Royal Botanic Gardens, Kew whose wide knowledge of African plants has been freely placed at our disposal.

II. *Conspectus of species*

1. **Ensete edule** (*Gmel.*) *Horan.* Prodr. Scitam. (1862), 41.

Musa ensete Gmel. Syst. Nat. ed. 13, **2,** (1791), 567 ; Baker in Ann. Bot. **7** (1893), 205. Type : from Abyssinia, description and plates in Bruce, Travels in Egypt, Arabia, Abyssinia and Nubia **5,** (1790), 36–41.

Ensete ventricosum (Welw.) Cheesman in Kew Bull. **1947,** 101 (*Musa ventricosa* Welwitsch Apont. (1859) 545 & 587, no. 45 ; Baker in Ann. Bot. **7** (1893), 206). Type : Welwitsch no. 6447, Pungo Andongo, Angola, 1857—"species ab omnibus mihi cujus generis cognitis caule basi bulboso-inflato et bracteis etiam sub statu fructificis persistentibus et distincta," in Herb. Kew. In Herb. Mus. Brit. are male flowers (with two additional lobes on the outer tepals, as in our Uganda material) bearing the same number and date and the note "Stem swollen above the ground, 8–10 ft. high."

Ensete buchanani (Baker) Cheesman *loc. cit.* 102 (*Musa buchanani* Baker in Ann. Bot. **7** (1893), 207). Type : J. Buchanan no. 470, Shire Highlands, Nyasaland. July 1885 ; in Herb. Kew.

Ensete schweinfurthii (K. Schum. & Warb.) Cheesman *loc. cit.* 103 (*Musa schweinfurthii* K. Schum. & Warb. ex K. Schum. in Engl. Pflanzenr. **4,** 45 (1900), 14). Type : Schweinfurth, 2nd ser. no. 130, Niamniam, A.-E. Sudan ; in Herb. Kew. & Herb. Mus. Brit. Description and specimens are poor but the large leaf in Herb. Kew. strongly suggests *E. edule*. It has evidently been confused with *E. gilletii* by Hutchinson and Dalziel (Fl. W. Trop. Afr. **2** (1936), 328), following remarks of Chevalier.

Ensete arnoldianum (De Wild.) Cheesman *loc. cit.* 103 (*Musa arnoldiana* De Wildemann in Bull. Soc. Etud. Colon. Brux. **8** (1901), 339 ; Not. Pl. Ut. Intér. Fl. Congo **1** (1903), 79 & t. 1 ; Pl. Trop. de Grande Culture **1** (1908), 378). Type : J. Gillet no. 1850, région de Dembo, Congo, 1901 ; in Herb. Brux.

Ensete holstii (K. Schum.) Cheesman *loc. cit.* 103 (*Musa holstii* K. Schumann in Engl. Bot. Jahrb. **34** (1904), 121. Type : A. Engler, Reise nach Süd- and Öst-Afrika, No. 2254, West Usambara, Tanganyika, 25.9.1902 ; in Herb. Kew. and Herb. Mus. Brit.

Ensete ulugurense (Warb. & Moritz) Cheesman *loc. cit.* 103 (*Musa ulugurense* Warburg & Moritz ex Warburg in Tropenpflanzer **8** (1904), 116). Type : not seen. From description, very near *E. holstii*.

Ensete fecundum (Stapf) Cheesman *loc. cit.* 103 (*Musa fecunda* Stapf in Journ. Linn. Soc. Bot. **37** (1906), 526). Type : M. T. Dawe no. 521, Isunga, Toro, Uganda ; in Herb. Kew.

Ensete laurentii (De Wild.) Cheesman *loc. cit.* 103 (*Musa laurentii* De Wildemann, Mission E. Laurent **1** (1907), 371 ; Pl. Trop. de Grande Culture **1** (1908), 379). Type : E. & M. Laurent, 15.1.1904, Stanleyville, Congo ; in Herb. Brux.

Ensete bagshawei (Rendle & Greaves) Cheesman *loc. cit.* 103 (*Musa bagshawei* Rendle & Greaves in Journ. Bot. **48** (1910), 169 and t. 506). Type : Bagshawe no. 1582, 25.4.1907, Foweira etc., Unyoro, Uganda, at 3500 ft. ; in Herb. Mus. Brit.

Ensete davyae (Stapf) Cheesman *loc. cit.* 104 (*Musa davyae* Stapf in Kew Bull. (1913), 102). Types : J. Burtt Davy, Zoutpansberg, Transvaal (drawings) and W. H. Johnson, Amatongas forest, Mozambique, 27.11.1907 ; in Herb. Kew.

Ensete ruandense (De Wild.) Cheesman *loc. cit.* 104 (*Musa ruandensis* De Wildemann in Bull. Jard. Bot. Brux. **8** (1923), 111). Type : cultivated at Kisantu, Congo by J. Gillet from seed collected in Ruanda by Durand, May 1923 ; in Herb. Brux.

Ensete rubronervatum (De Wild.) Cheesman *loc. cit.* 104 (*Musa rubronervata* De Wildemann in Bull. Jard. Bot. Brux. **8** (1923), 112). Type : J. Gillet, *s.n.* Kisantu, Congo, 1923 (evidently cultivated here from seed from Ruanda collected by Durand) ; in Herb. Brux.

Specimens examined (excluding types and recent collections by the authors :

Belgian Congo : *Ambroise s.n.*, Romée (Stanley Falls), in Herb. Brux. ; *Vanden Brande* no. 164, Gorge de la Rivière Kibobwa, 5.5.39, in Herb. Brux. ; *Bequaert* no. 3477, Ruwenzori, 1910, in Herb. Brux. ; *Lebrun* no. 4407, Ruwenzori, Nov. 1931, in Herb. Brux. ; *Seret s.n.*, Poste de Zobia, 1907, in Herb. Brux. ; *Vanden Brande* no. 4947, Lukafu, Aug. 1937, in Herb. Brux. ; *Pynaert* no. 89, cultivated at Isangi, 16.6.1905, in Herb. Brux. (cited by De Wildemann as *E. laurentii*).

Abyssinia : *Plowden s.n.*, 1856, in Herb. Kew.

Uganda : *Eggeling* no. 1758, March 1935, Paimol, Chua District, in Herb. Kew. ; *Eggeling* no. 3626, Kalinzu Forest, Ankole, in Herb. Kew. ; *Bagshawe* no. 972, Fort Portal in Herb. Mus. Brit. ; *Scott Elliot* no. 7165, Kampala, in Herb. Kew. ; *A. S. Thomas*, no. 1465, Bwamba Pass, Toro at 6700 ft., in Herb. Kew. ; *A. S. Thomas*, no. 1957, Amua, West Nile, in Herb. Kew. ; I.C.T.A. Introduction no. 331, coll. *J. Owen*, 1948, Masindi ; I.C.T.A. Introduction no. 164, coll. *G. B. Masefield*, 1936, Kalisizo, Masaka District.

Kenya : *P. R. O. Bally*, Museum no. 8079, Chyulu hills, in Coryndon Museum, Nairobi and in Herb. Kew.

Tanganyika : *F. M. Rogers, s.n.*, 1926, Amani, in E. Afr.: Herb. and Herb. Kew. ; I.C.T.A. Introduction no. 339, coll. *A. H. Savile*, 1949, Morogoro ; I.C.T.A. Introduction no. 340, coll. *D. H. Goode*, 1949, Mufindi ; I.C.T.A. Introduction no. 311, coll. *H. Gillman*, 1948, Buga Plateau, Mpwapwa district ; I.C.T.A. Introduction no. 243, coll. *G. A. C. Herklots*, 1939, Ngorongoro.

Nyasaland : *Herklots*, Chintewdete, in Herb. Kew. ; *Kirk*, hills south of Lake Nyasa, in Herb. Kew. ; *L. J. Brass*, no. 17795, Cholo Mt., in Herb. Kew. ; I.C.T.A. Introduction no. 341, coll. *W. J. Badcock*, 1949, Chintembwe.

Southern Rhodesia : *Crook* no. 279, 11.11.50, in Herb. Pretoria and Herb. Kew. ; *Crook* no. 342, 30.12.50. Bridal Veil Falls, Melsetter, in Herb. Pretoria and Herb. Kew.

Northern Rhodesia : I.C.T.A. Introduction no. 330, coll. *P. E. Glover*, 1948, Kalambo Falls.

Transvaal : *Worsdell*, Dec. 1909, Pietersburg, in Herb. Kew.

Remarks : *E. edule* is a large or even gigantic plant with a distinct banana-like crown of large leaves ; the seeds are large, 12–17 mm. in diameter. Distribution is in moist places, commonly shady, sometimes swampy, through Abyssinia, A.-E. Sudan, Kenya, Uganda, Tanganyika, Nyasaland, Mozambique, Transvaal, Northern & Southern Rhodesia, Angola, Ruanda-Urundi, Belgian Congo. It is thus generally distributed through Central and East Africa and has a more easterly distribution than *E. gilletii*, though sympatric with it over a considerable area.

2. **Ensete Gilletii** (*De Wild.*) *E. E. Cheesman* in Kew Bull. (**1947**) 103.

Musa gilletii De Wildemann in Rev. Cult. Colon. **8** (1901), 102 ; Not. Pl. Ut. Intér. Fl. Congo **1** (1903) 73 seq. and t. 5 & 6. Type : Gillet no. 700, Kisantu, lower Congo, 1900 ; in Herb. Brux.

Musa chevalieri Gagnepain in Bull. Soc. Bot. Fr. **58,** mém. 8 (1908), 87). Types : Chevalier, no. 5446, Krébedgé, Haut Oubangi ; Chevalier no. 6059, Fort Sibut, Haut Oubangi ; Chevalier no. 8389, Kouti, Haut Chari (all in Herb. Paris). The description was evidently based also on notes and photographs lodged in Herb. Paris. One photograph shows a plant undoubtedly *Ensete gilletii* and this, together with the seeds 7–8 mm. in diameter, identifies the species.

Specimens examined :

Sierra Leone : *Deighton* no. 2582, Njala, Northern Province in Herb. Kew. ; *Barter, s.n.*, 1893, seeds strung on a necklace, in Herb. Kew.

Nigeria : *W. G. Freeman*, 24.6.1904, in Herb. Kew. ; *B. D. Burtt, s.n.*, 1938, in Herb. I.C.T.A. ; *R. W. J. Keay*, F.H.I. no. 28003, Zaria, in Herb. Kew.

French Cameroons : *Milbraed*, no. 9337, Buar, in Herb. Kew.

Belgian Congo : *D. Cabu* no. 156, Lubudi, Upper Katanga, in Herb. Brux. and Herb. Kew. ; *P. Quarré* no. 7966, Lubumbashi, in Herb. Brux.

Nyasaland : *Kirk, s.n.*, Tohinsunze, Shirwa, April 1859, in Herb. Kew. ; *Kirk, s.n.*, hills south of Lake Nyasa, in Herb. Kew. (dried seeds strung on a necklace) ; I.C.T.A. Introduction no. 342 coll. *W. J. Badcock*, 1949, Ncheu.

Angola : *Gossweiler* no. 4715, Capichongo, Ambaca, 2.6.1910 in Herb. Kew.

Remarks : *E. gilletii* is intermediate in size between the other two species. The leaves, rather than being aggregated in a distinct crown as in *R. edule*, are spread along the stem, giving a canna-like aspect reminiscent of *E. homblei* ; this is well shown in the photographs of De Wildemann and Chevalier cited above and also in one by R. W. J. Keay in Herb. Kew. The seeds also intermediate, about 7–9 mm. in diameter. Distribution (perhaps in drier habitats than *E. edule*) in Nyasaland, Angola, Belgian Congo, Cameroons, Ubangi-Shari, Nigeria and Sierra

Leone, a more westerly distribution than that of *E. edule*. Shows a tendency (according to De Wildemann) to die down to a perennating corm in unfavourably dry seasons. (cf. *E. homblei* and remarks appended thereto). Much more information is needed on biology and life-cycle.

3. **Ensete homblei** (*Bequaert ex De Wild.*) *E. E. Cheesman loc. cit.* 103 ; E. Milne-Redhead in Hook. Icon. Pl. (1952), t. 3479 A & B.

Musa homblei Bequaert ex De Wildemann in Ann. Mus. Colon. Marseilles sér. 2, **10** (1912), 332. Type : Homblé no. 671, termite mounds near Elisabethville, Belgian Congo, May 1912 ; in Herb. Brux.

Belgian Congo : *Quarré* no. 1961, Katanga, in Herb. Brux. This plant grew at the foot of termite mounds (as Bequaert noted of the type) and, though lack of seed prevents certain determination, is probably *E. homblei* rather than small *E. gilletii*.

Northern Rhodesia : *E. Milne-Redhead* no. 3062, Matonchi Farm, Mwinilunga District, 2.11.1937, in Herb. Kew.

Remarks : *E. homblei* is a tiny species with small leaves, more cannathan banana-like in general aspect. The seeds are small, about 5-6 mm. in diameter. Distribution is restricted, in the southeastern Belgian Congo (Katanga) and neighbouring Northern Rhodesia. The species shows a marked tendency to die down to a scale-covered corm at times and this is apparently an ecological adaptation to a dry grassland habitat liable to fires. The apparent tendency to suckering and therefore to a perennial habit which has been noted by several authors is probably due to aggregated germination and hence to growth of seedlings in clumps, each individual seedling being truly monocarpic even if it grows up and dies down several times before flowering. Detailed observations of the life-cycles of living plants of this and the preceding species would be very desirable. Milne-Redhead (*loc. cit.*) has suggested that *E. homblei* might be better placed in a distinct monotypic genus ; the case for this procedure, however, is seriously weakened by the realisation that *E. gilletii* is more or less intermediate between *E. homblei* and *E. edule*, and Mr. Milne-Redhead (in conversation) agrees with us in this view.

Rejected species

Ensete livingstonianum (Kirk) Cheesman *loc. cit.* 101 (*Musa livingstoniana* Kirk in Journ. Linn. Soc. **9** (1867), 128, *nomen confusum*). Type : J. Mahon, Zomba, Nyasaland, in Herb. Kew.

The type is a packet of seeds (evidently collected from the ground, not from a living plant) which matches *E. gilletii*. But the description of the plant could only refer to *E. edule* and the name is therefore treated as a *nomen confusum*.

Ensete proboscideum (Oliver) Cheesman *loc. cit.*, 102 (*Musa proboscidea* Oliver in Hook. Icon. Pl. **18** (1888), t. 1777 *nomen dubium*). Type : Sir John Kirk, *s.n.*, a packet of seed from "the hills of Ukami about 100 miles inland to the West of the Island of Zanzibar," and three photographs, probably of cultivated plants growing in Zanzibar.

The photographs show a plant probably 8 10 ft. high (there is no scale) on which all the leaves are dead and the probably over-ripe bunch bears a very long male rachis from which all the bracts have fallen. The seed resembles that of *E. gilletii* but approaches *E. edule* in size (10 × 10 - 11 mm.). It is most probably a small-seeded form of *E. edule* but the

inadequacy of description and typification constrain us to treat it as a *nomen dubium.*

Ensete elephantorum (K. Schum. & Warb.) Cheesman *loc. cit.* 102 (*Musa elephantorum* K. Schumann & Warburg ex K. Schum. in Engl. Pflanzenr. **4,** 45 (1900), 14, *nomen dubium*). Type : in Herb. Berlin, destroyed.

The description is poor ; identification is impossible without the type and the name must therefore be regarded as a *nomen dubium.*

Ensete religiosum (Dybowski) Cheesman *loc. cit.* 103 (*Musa religiosa* Dybowski in Rev. Hort. **72** (1900), 262, *nomen nudum*).

There is no type and the species, based on plants grown in Paris from seed collected in the French Congo, was never properly described. Letters and specimens of seed in Herb. Brux. communicated by Dybowski to De Wildemann, however, make it clear that this is *E. gilletii*, over which *E. religiosum* would have had priority as a name had it been properly described.

Musa dybowskii De Wildemann, *nomen nudum.*

Musa martretiana A. Chevalier, *nomen nudum.*

Musa riperti A. Chevalier, *nomen nudum.*

III. *The significance of seed size*

The seeds of *Ensete* seem to offer the best diagnostic characters available in this difficult group and, in particular, size is important for distinguishing the species. Length, breadth and thickness of samples of seeds (ten when possible, but often perforce fewer than ten) were recorded and the data are summarized below as mean cubic measures derived from multiplying together the three linear dimensions (in centimetres). Samples are recorded in descending order of size.

ENSETE EDULE

Bally, southern Kenya*	5·67	I.C.T.A.311, Buga, Tanganyika	2·36
E.A.183, Amani, Tanganyika†	5·48	E.A.113 (a), Fort Portal, Uganda	2·32
Rogers, Amani, Tanganyika	4·83	Dawe, Toro, Uganda (*E. fecundum*)	2·31
Herklots, Chintewdete, Nyasaland	4·29	Laurent, Stanleyville, Belgian Congo (*E. laurentii*)	2·30
Welwitsch, Angola (*E. ventricosa*)	4·23	Durand, Ruanda (*E. ruandense*)	2·28
Kirk, Nyasaland	3·88	Eggeling, Ankole, Uganda	2·23
E.A.225, Kilimanjaro, Tanganyika	3·66	E.A.28, Nairobi, Kenya from Abyssinia	2·21
Worsdell, Transvaal	3·58	E.A.117, Fort Portal, Uganda	2·81
Plowden, Abyssinia	3·33	Eggeling, northern Uganda	2·17
Vanden Brande, southern Belgian Congo	3·24	Bagshawe, Fort Portal, Uganda	2·15
Lebrun, Ruwenzori, Belgian Congo	3·04	Durand, Ruanda (*E. rubronervatum*)	2·08
E.A.213, Kilimanjaro, Tanganyika	3·02	E.A.21, Gura River, Kenya	2·00
E.A.16, Lari Forest, Kenya	2·90	I.C.T.A.331, Masindi, Uganda	1·96
E.A.121, Kichwamba, Uganda	2·87	E.A.113(b), Fort Portal, Uganda	1·92
E.A.114, Fort Portal, Uganda	2·74	E.A.26, Meru, Kenya	1·83
E.A. *s.n.*, Nairobi, Kenya from Abyssinia	2·74	Ambroise, Stanleyville, Belgian Congo	1·83
Crook, S. Rhodesia	2·64	I.C.T.A.331, Masindi, Uganda	1·82
E.A.48, Maragoli, Kenya	2·61	Bagshawe, Uganda (*E. bagshawei*)	1·72
Seret, northeastern Belgian Congo	2·58	Scott Elliot, Kampala, Uganda	1·66
E.A.116, Fort Portal, Uganda	2·53	E.A.27, Meru, Kenya	1·64

*Estimated from photograph
†Seeds slightly immature

Doubtful identity

Kirk, Tanganyika (*E. proboscideum*) 1·11

ENSETE GILLETII

Kirk, Nyasaland	0·69	Barter, Sierra Leone	0·60
Keay, Zaria, Nigeria	0·61	Cabu, Katanga, Belgian Congo	0·59
Mahon, Zomba, Nyasaland (*E. livingstonianum*)	0·61	Freeman, Nigeria	0·56
		Kirk, Nyasaland	0·53
Deighton, Northern Province, Sierra Leone	0·61	Gillet, Lower Congo (Type)	0·46
		"*E. religiosum*", Herb. Brux.	0·38
Gossweiler, Angola	0·60		

ENSETE HOMBLEI

Milne-Redhead, N. Rhodesia	0·22	Homblé, Katanga, Belgian Congo (Type)	0·16

Some signs of geographical differentiation may be discerned in the data for *E. edule*. Seeds are smallest in the centre of the range, namely in central Kenya, Ruanda, and Uganda where the range is 1·64–2·90 ; they are somewhat larger in the Congo (range 1·83–3·24) and larger still (2·64–5·67) around the eastern and southern margins of the distribution, in Abyssinia, Mozambique, Transvaal, Rhodesia and Angola ; the largest of all occur in southern Kenya and northeastern Tanganyika, but even there they are not uniformly large for I.C.T.A. no. 311 from the Buga plateau near Mpwapwa had comparatively small seeds. Thus there are no discontinuities in the variation which might make possible the discrimination of smaller taxonomic units.

Passing over the mysterious *E. proboscideum*, it will be seen that *E. gilletii* nowhere approaches *E. edule* and that, within the species, there is no evident geographical correlation with seed size. It appears at first sight to be less variable in this character than *E. edule* and this impression is supported by a simple statistical comparison, thus :—

	Mean	Standard deviation	Coefficient of variation per cent.
E. edule	2·72*	0·92	34
E. gilletii	0·56	0·088	16

IV. *Notes on recent collections of Ensete edule*

Recent collections of *Ensete edule* from East Africa must now be considered with a view to understanding better the variability of the species. Specimens are deposited in the Kew Herbarium. E.A. numbers refer in these notes, as in the list of seed sizes above, to our own collections made in the field in East Africa.

1. *Kenya* : Scott Laboratories, Nairobi (E.A.28) Alt. 5500 ft., 6.10.48. The plants had been established from seed from Abyssinia about four years previously.

Plants tall and robust, pseudostems 2·5–3·0 m. high, green or blackish-purple. *Leaves* glaucous beneath ; midribs green or variably flushed pink. *Bunch* sub-pendulous, clothed with persistent bracts ; female axis 25 × 8 cm. *Fruits* about 16 in each of 20 hands, ripening white-green-orange, moderately pulpy, smooth and slightly shiny, very tightly packed,

*The Bally specimen excluded from these calculations since not actually measured.

9 cm. long, 4 cm. diam., obtuse at the distal end, tapering abruptly to a short pedicel ; *seeds* large, 1·5–1·8 × 1·2–1·5 × 0·9–1·2 (est. vol. 2·21) cm., black, irregular in shape, striate, with large sunken triangular hilum and callus bump with prominent crescent-shaped hollow at the opposite end ; *male axis* 70 cm. long concealed by the persistent bracts ; *male bud* massive, 30 × 13 cm., ovate, broadest above the centre ; *bracts* dull, slightly furrowed, pale greenish-yellow at base (glaucous externally) shading to dull purple with greenish streaks apically, pale greenish within, apex obtuse, rounded, tips imbricate and slightly divaricate ; *male flowers*, the perianth pale yellow, *outer tepal* 5 cm. long, 3-lobed, the inner tepal nearly circular, serrate-apiculate, 1·5 × 1·3 cm. the apiculus 0·9 cm. long ; *stamens* 5, *filaments* 2 cm., *anthers* 3 cm. long, deep blackish purple, *staminode* acicular, 0·9 cm. long, *style* acicular 1·6 cm. long.

2. *Kenya* : Lari Forest Reserve (abandoned native garden), Alt. 7500 ft., 29.8.48 (E.A.16).

Plant about 5 m. high, *pseudostem* 2·5 m., green with purple-bronze markings on upper sheaths, 75 cm. thick at base, 45 cm. at breast-height ; *latex* pale whitish, reddening on exposure, turning purple with iron. *Leaves* erect or spreading, 2·5 × 1·0 m. or more, lanceolate ; midrib broad, deeply channelled above, very prominent beneath, petiole lacking. *Female rachis* massive, divergent from the pseudostem ; bracts persistent, their insertions prominent, concealing the fruits ; *fruits* about 20 in each of 24 hands, biseriate, tapering to the base, but hardly pedicellate, up to 15 cm. long and 4·5 cm. diam. with persistent style and floral remains, very densely packed, green turning orange from the base, pulp orange, edible, but poor to taste ; *seeds* 18–34 per fruit in three loculi ; large 1·4–1·9 × 1·3–1·6 × 1·0–1·3 cm. (est. vol. 2·90), black, irregular in shape, striate, with large sunken triangular hilum and indistinct hollow at opposite end ; *male rachis* pendulous, 120 cm. long, 10 cm. thick above, tapering slightly below, clothed with persistent bracts ; *male bud* massive 27 × 18 cm., ovoid, broadest above the centre, slightly imbricate at tip ; *bracts* pale green, shiny whitish at base, apex obtuse or sub-acute ; *male flowers* 30–40 per bract, biseriate, white with the perianth tipped orange yellow, *outer tepal* 4·5 cm. long ; 3-lobed, inner tepal serrate-apiculate, 1·4 × 1·2 cm., the apiculus 1·0 cm. long ; *stamens* 5, the filaments white, 1·7 cm. long, the anthers 2·5 cm. long, purple, apically deflexed at anthesis, *staminode* not seen, style 1·3 cm. acicular ; pollen abundant, greyish and sticky.

Only differing from the plants growing at the Scott laboratories (E.A.28) in the size of the staminode and not otherwise to be distinguished from them.

3. *Kenya* : Nyambeni Hills ca. 25 miles NE. of Meru ; Alt. 5100 ft. 3.10.48 (E.A.27).

Plants tall with purple-bronze marks on the upper parts of the leaf-sheaths, and green midribs ; *fruits* ripening bright orange, soft and tasteless, 10·5–11·5 cm. long, 3·5 cm. diam.tapering into an indefinite pedicel, persistent style and floral remains, 20–29 seeds in each ; *seed* medium-large, black, slightly striate, irregular in shape 1·2–1·5 × 1·2–1·4 × 0·9–1·1 cm. (est. vol. 1·64), hilum triangular and deeply sunken, variable marking from definite callus bump with hollow in centre to no visible

mark at opposite end ; *female flowers*, ovary 4·5 cm. at opening, *outer tepal* 3 cm. long, 3-lobed, *inner tepals* 3, shortly apiculate, *stam.* none, *staminodes* 3, 1 cm. long, *style* 2·5 cm. long, *stigma* 4 × 4 × 3 mm., capitate; *male flowers*, *outer tepal* 4·5 cm. long, 3-lobed ; *inner tepal* serrate-apiculate, 1·4 × 1·1 cm. short-apiculate, apiculus 0·3 cm. long, *staminode* minute, 0·1 cm. long or absent, style 0·7 cm.

This collection has the smallest seed in any of our specimens (near that of the type material of *E. bagshawei* from Uganda). It is also the only specimen in which we have found true female flowers with no functional stamens. All other hermaphrodite flowers examined have 2, 3, 4 or 5 stamens. It differs from all other collections except E.A.20 from Nyeri, Kenya, in having, in the female flowers, a three-lobed outer tepal and three separate, apiculate, inner tepals (two specimens in Herb. Mus. Brit., the type of *E. bagshawei* and a collection from near Fort Portal, Uganda, show an extra inner tepal in the *male* flowers).

Other Kenya collections (E.A.21, Gura River Valley, Aberdare Mts., 1.10.48 ; E.A.26, Mt. Kenya, near Meru, 2.10.48 ; and E.A.48, Maragoli, Kisumu area, 9.10.48) show no noteworthy features except that the plants from the Gura River Valley, growing on an exposed hillside, were relatively short (pseudostems 4–8 ft.) while those from a shady forest on Mt. Kenya were tall (pseudostems 8—14 ft.) as would, indeed, be expected.

4. *Uganda* : Several collections from near Fort Portal, Western Uganda (including one from Lake Isunga, the type locality for *Ensete fecundum*) agree closely with each other and with material collected by Eggeling (1758 and 3626 in Herb. Kew.), M. T. Dawe (521, type of *M. fecunda* in Herb. Kew.) and Bagshawe (972 in Herb. Mus. Brit.) from similar localities.

E.A.116, swampy hollow, 6 miles NE. of Fort Portal, on the Ndaiga rd., alt. 5000 ft., 20.10.48, growing amongst a mass of *Pennisetum purpureum* and *Oreobambos buchwaldii* on damp, but not inundated ground, may be described as typical.

Plants tall, leaves up to 4·5 × 1·5 m., glaucous or not, midribs red or not ; purple staining of pseudostem very variable. *Fruits* orange when ripe, 13 cm. long, 3·5 cm. in diam., with persistent style and floral remains, containing many seeds, tapering to a short pedicel ; *seeds* large, black, striate, irregular in shape, 1·4–1·7 × 1·2–1·5 × 1·1–1·2 cm. (est. vol. 2·53), hilum triangular and deeply sunken, callus bump with small hollow in the centre on distal face ; *hermaphrodite* flowers, *outer tepal* 4·5 cm. long, 3-lobed, with two extra lobes, alternate with the three main lobes, attached to its inner surface, *inner tepal* slightly serrate-apiculate, 1·5 × 1·5 cm., the apiculus 0·6 cm., *stam.* 3, filaments 2·0 cm., anthers 2·0 cm. long, *staminodes* variable in number and length ; *style* 4 cm. long, *stigma* capitate, 6 × 5 × 5 mm.; *male flowers*, *outer tepal* 5 cm. long, 3-lobed, *inner tepal* serrate-apiculate 1·5 × 1·4 cm., the apiculus 0·4 cm., *stam.* 5, filaments 2·5 cm., anthers 2·5 cm. long, *staminode* 1, 0·4–0·6 cm. long ; style 1·2 cm. long.

The only new feature in comparison with Kenya collections (seen also in plants near the Mpanga River bridge Hima Forest, near Fort Portal) is that the bracts are semi-deciduous, so that the male rachis is ultimately

more or less exposed. Experience with bananas indicates that the persistence or otherwise of the bracts is a character of minor importance.

5. *Tanganyika* : E.A.213, Nanga River Valley, S. Kilimanjaro, alt. 5500 ft., 13.11.48 ; common on cleared hillsides and along streams.

Midribs red or green ; male bud degenerating as the fruits ripened ; bracts green with pale red tinge externally, more or less deciduous but not cleanly so. *Fruits* 9 cm. long, 3 cm. diam., tapering to a short pedicel, with persistent style and floral remains ; *seeds* few, 3–5, per fruit (exceptional ? due to imperfect setting), large, 1·7–1·8 × 1·4–1·6 × 1·1–1·3 cm. (est. vol. 3·02), more or less smooth, less angular and more rounded in shape, with large deep triangular hilum and callus bump, with crescent shaped depression in its centre, on distal face ; *hermaphrodite flowers* not seen ; *male flowers*, *outer tepal* 3·5 cm. long, 3-lobed ; *inner tepal* not serrate, 1·2 × 1·0 cm., shortly apiculate, the apiculus 0·2–0·4 cm. long ; *stam.*, 5, filaments 1·5 cm. anthers 2·0 cm. long, *staminode* not seen, *style* 0·5 cm. long.

Differing from other collections in minor characters : such as smaller number and slightly larger size of seed ; smooth edge and short apiculus of inner tepal, and deciduous bracts of male rachis, but still undoubtedly within the species.

6. *Tanganyika* : Usambara Mts. There remains for discussion a variant of the species of which we have a somewhat fragmentary specimen from Amani, Usambara Mts., which is characterized by its very large seeds. Photographs by Greenway (6442 in Herb. Kew.) show a plant with a massive pseudostem at least 8 ft. tall and a bunch with persistent bracts on the male rachis. Our E.A.183 was an isolated plant in a wooded valley at Monga Estate about 5 miles from Amani, alt. 3000 ft., 10.11.48.

Plant short, pseudostem 2 m. tall. *Male bud* massive, 35 × 13 cm., slightly imbricate at tip. *Bracts* persistent, externally pale green and glaucous below, deep violet-purple above, greenish near the obtuse apex ; internally yellowish white at base, pale crimson above, tinged green near the apex. *Fruit* rather short and blunt 8·5–9·5 × 4 cm., tapering to an indefinite pedicel with persistent style and floral remains, stigma large, 8 × 6 × 4 mm. ; *seeds* very large 2·0 × 1·6–1·8 × 1·4–1·6 cm. (est. vol. 5·48). These seeds were immature so that size may have been overestimated ; similar seeds from the Amani herbarium measured 1·8–2·2 × 1·5–1·9 × 1·2–1·4 cm., striate, irregular in shape, with large deep triangular hilum and callus bump with a depression in its centre at the distal face ; *male flowers*, *outer tepal* 4·5 cm. long, 3-lobed, *inner tepal* serrate apiculate, 1·5 × 1·5 cm., the apiculus 0·7 cm. ; *stam.* 5, filaments 2·0 cm., anthers 3·0 cm. long, *staminode* minute, 2·0 mm. long, *style* 1·0 cm. long. The perianth white, tinged yellow near the apex, the anthers yellow with pale violet loculi.

Differs from other collections in colour of bracts, in size and shape of fruit (slightly) and in size of seed, but there is no truly distinctive character or assemblage of characters to recommend the retention of the *Ensete holstii* for this and similar specimens.

Another collection of this kind is that of P. R. O. Bally (Museum no. 8079) of the Coryndon Museum, Nairobi, from the central and southern

Chyulu hills, S. Kenya. His photographs show a huge plant with a pseudostem some 12 ft. high ; persistent bracts on the male rachis, and rather broad, short fruit containing very large seed up to 2 cm. in diameter. We are indebted to Mr. Bally for male flowers of this specimen, which are remarkable only for their large size ; *outer tepal* 5·5 cm. long, 3-lobed, *inner tepal* serrate-apiculate 1·5 × 1·3 cm. the apiculus 1·3 cm., *stam.* 5, filaments 2 cm., anthers 3 cm. long ; *staminode* minute, 1 mm., *style* 1·3 cm. long.

V. *Ensete edule—a general description and discussion*

A variable species widely distributed in tropical Africa usually found in swamps, on river banks or in forest clearings. *Height* overall 4–9 m., *pseudostem* 1·5–5 m., often variably stained purple or purplish brown ; *leaves* erect or spreading, lanceolate up to 5 m. long and 1·5 m. broad, glaucous or not, midribs red or green ; *latex* pale whitish, reddening on exposure ; *female rachis* massive, the bracts concealing the fruits, *male rachis* tapering, the bracts persistent or partially deciduous ; *fruits* biseriate, 5–20 or more in up to at least 24 hands, tapering to the base, but hardly pedicellate, 8–15 cm. long and up to 4·5 cm. diam., orange at maturity, usually with persistent style and floral remains, trilocular ; *seed* usually 15–25 per fruit but varying from 0 to 35 or 40, embedded in an edible, tasteless, orange pulp, variable in size from 1·2–2·3 × 1·2–1·8 × 0·9–1·6, variable also in shape from nearly spherical to flattened and irregular and in markings from deeply striate to almost smooth, usually but not always with a lump of callus opposite the hilum, sometimes with a shallow depression in its centre ; *flowers* usually hermaphrodite and male, occasionally female ; *hermaphrodite flowers*, ovary 4–7 cm. long at opening, perianth variable ; *outer tepal* either three-lobed or with one or two smaller, acicular extra lobes attached to it internally ; *inner tepals* 1–3, variable in shape with two wings and an apiculus, the latter variable in length up to 1·5 cm. ; *stamens* 0–5, 3·5 cm. long, the anthers usually slightly longer than the filaments, violet to dark purple in colour, style 2·5–4 cm. long with large capitate stigma ; *staminodes* variable in number and size, depending on the number of stamens present ; *male bud* massive, up to 35 × 13 cm., declining in size with age, bracts acute or obtuse, slightly imbricate, variably coloured red or purple or pure greeen ; *male flowers* up to 30–40 per bract, biseriate, usually white with the perianth tipped orange yellow ; *outer tepal* 3-lobed, the lobes variable in length, 3·5–5·5 cm. long ; *inner tepal* serrate-apiculate, 1·0–1·5 × 1·0–1·7 cm., the apiculus 0·3–1·3 cm. or occasionally absent ; *stamens* 5, 3–5 cm. long, the violet to purple anthers usually somewhat longer than the white filaments; *pollen* yellow to greyish, abundant, staminode absent, or minute and acicular, 0·1–1·0 cm. ; style acicular 1–2 cm. long. Distribution in Abyssinia, Kenya, Uganda, Tanganyika, Nyasaland, Mozambique, Transvaal, Rhodesia, Angola, the Belgian Congo, Ruanda-Urundi and the Cameroons, at middle altitudes.

We have seen that *E. edule* is variable and it will be well to consider now some of the sorts of variation present and see whether any of them can be put to taxonomic use. First, much of the variation in stature, vigour, seed fertility and so forth is obviously mere fluctuation called forth by differing elevations, soils, drainages, aspects, degrees of shade and so on.

There may well be true genetic variation in these characters but if so it is obviously useless for practical taxonomic purposes because concealed by environmental fluctuations of equal or greater magnitude ; detailed experimentation alone could reveal it.

Second there is probably some genetical variation in the species which, for present purposes, can be classified as that which occurs geographically at random and that which shows some geographical correlation. Examples of the former are presumably to be found in leaf-midrib and bract pigmentation, waxiness, bract persistence and in certain floral details. The following data illustrate the randomness of the variation in midrib colour ; the figures represent percentages of plants having red midribs in various localities :—

Country	*Area*	*Locality*	*Altitude*	*% Red midribs*
Kenya	Aberdares	Lari	7500	0
		Gura River	7000	50
	Mt. Kenya	Meru	6400	50
		Katheta River	5500	90
		Rungui River	4500	10
		Thuchi River	4700	10
		Nyambeni	5100	0
Uganda	Fort Portal	Hima	5000	0
		Isunga	5500	0
		Fort Portal	5000	20
		Kichwamba	5000	50
		Wasa River	6000	20
	Rubirizi	Nkugute Lake	4300	0
		Kilinzu Forest	5000	0
		Kyamahunga	4700	30

With regard to floral structure it is evident that the functionally female flowers are rarely purely female (E.A.27) ; more commonly they are hermaphrodite but very variable in the construction of the perianth and in the numbers of stamens (these characters may, indeed, vary in different parts of the same inflorescence). Male flowers are more constant as to the numbers of their parts but vary greatly in size (this is at least partly correlated with the age and hence the size of the bud) and in the shapes of the perianth parts, characters used by De Wildemann, for example, as interspecific key characters. All this variation is intrinsically interesting but taxonomically worthless as it stands, for it is correlated neither with other variation nor with geography.

Seed size, however, is correlated with geography, as has been shown above. The data are insufficient for a very precise statement but it seems clear at least that the species in the centre of its range, in Kenya and Uganda, has smaller seeds than further west, in the Congo, and that the largest seeds are found round the southern margins of the distribution, from Angola through the Transvaal and Nyasaland to Tanganyika and southern Kenya, and in the North-East, in Abyssinia. But the ranges of size overlap considerably and discontinuities or correlations which could be used taxonomically are lacking, or are at least not apparent to our present knowledge. Seed size, therefore, can not be made the basis for a finer taxonomic discrimination than we have adopted, though it

could well become an important feature of such more elaborate treatment as new information gathered in the future may allow.

Finally, a few comments on ecology, uses and history may be made. *Ensete edule* is a plant of the middle altitudes, ranging down to low levels in the western Congo and up to 7500 ft. and perhaps more in Kenya (Aberdare Mts.) and Uganda (Mt. Ruwenzori). Like the majority of the *Musaceae*, it is a plant of moist and open habitats, rather than an inhabitant of closed woody communities. It occurs mainly on river sides, swamp margins and forest clearings, rarely or never in dense shade. Seedlings are said to spring up in large numbers in wet weather following firing of the elephant grass in swampy places in western Uganda. The seeds are evidently capable of prolonged viability in the soil (for at least 25 years according to Mr. V. A. Beckley) and are presumably widely dispersed by monkeys and birds. Many fruits, however, are simply dropped whole at ripeness and this accounts for the frequently highly gregarious germination and the occurrence of clumps of mature plants which simulate the suckering habit of the true bananas. That suckering is not responsible, however, can be (and indeed was by us on several occasions) shown by careful excavation.

The only disease we noted on the species was a minor leaf spot due, apparently, to *Chloridium musae* Stahel.

The uses of the species are various though none are now very important. The leaves provide thatch, umbrellas, mats and wrapping materials as banana leaves do anywhere in the tropics. The sheaths yield a fibre which has long been a minor article of commerce between Abyssinia and northern Kenya (information from Mr. V. A. Beckley) and which has recently, under commercial test, been shown to have acceptable cordage properties. The soft inmost sheaths and shoot are sometimes used as a vegetable, as Bruce relates of Abyssinia. The endosperm yields a pure edible starch and the seeds are often strung together as necklaces and other similar ornamentation. Small boys suck the starchy pulp around the seeds and the milky latex is locally (e.g. in western Uganda) regarded as a stimulant to milk-flow in nursing mothers.

Recent archaeological investigations in Egypt have shown that the species once had much greater economic importance than it has nowadays (V. Laurent-Täckholm, Ann. Serv. Ant. de L'Egypte, **51** (1952), 299–312). In Neolithic times, during a warm wet climatic phase, *Ensete edule* was extensively cultivated for food in marshy lands in Upper (i.e. Southern) Egypt and representations of it have survived on the pottery of the period. Though principally cultivated as a food crop it seems possible that it was also used by its neolithic cultivators for textile fibre and it may later have been the " byssus plant " from which the royal linen was made. A stylized version of the Naqada pottery drawings survived into the dynastic period of Egyptian history as a hieroglyph of which Laurent-Täckholm says " It is read *su* or *su-t* or *nesu-t* (plant of the South, king of the South), or in combination with *r*, *res* (the South). It also enters in a great number of hieroglyphic signs." By this time, however, Upper Egypt had become cooler and drier than it had been before, cultivation of *Ensete edule* had declined, and the memory of the plant in Egypt survived only as a hieroglyph bearing a meaning associated with the place of its earlier cultivation—Upper Egypt.

NOTES ON AFRICAN PEDALIACEAE.

E. A. Bruce

Sesamothamnus Welw.

In connection with work on the East African Flora, the position of *Sesamothamnus* in the family Pedaliaceae was examined and it was felt that perhaps the genus might be better placed in the Bignoniaceae. With this end in view some research was done on these two families to determine the correct position of *Sesamothamnus*.

The delimitations of both Bignoniaceae and Pedaliaceae are very vague, and it is clear that the two families are very closely related. This has been pointed out by Dr. C. E. B. Bremekamp in his paper on " The Position of the genus Thomandersia Baill[1]." The main points of difference between the two can be summed up as follows :—

The Pedaliaceae are mostly herbaceous plants with characteristic mucilage glands and simple leaves. The ovary is usually bicarpellary, though this is often divided by a false septum into four compartments containing one to many ovules. The disc is usually unilateral, the calyx 5-partite, the corolla usually obliquely campanulate and the endosperm very thin.

The Bignoniaceae are mostly shrubs or trees with generally compound leaves and possess several different types of glands[2], but none secreting mucilage. The ovary is normally 2-celled with numerous ovules and not divided at this stage by a false septum though there are a few exceptions to this rule ; the disc is symmetric, the calyx spathaceous or 5-fid not 5-partite, the corolla large and variable in shape, the endosperm wanting and the seeds usually winged.

Sesamothamnus is a small tree or shrub covered with numerous mucilage glands and possessing simple leaves. The ovary is bicarpellary divided by a false septum into four compartments containing numerous ovules, the disc is unilateral, the calyx 5-partite, the corolla large with a cylindrical tube usually spurred at the base and a spreading limb, the endosperm (according to the original description) is wanting and the seeds are winged. I am indebted to Dr. C. R. Metcalfe for carrying out an anatomical investigation of *Sesamothamnus* and allied genera, which revealed the following points :—there is a thin layer of tissue within the seed coat, which has every appearance of being endosperm, the structure of the stomata, petiole and stem are comparable to those of other Pedaliaceae and the petiole and stem structure particularly show a very close agreement with those of the Mascarene genus, *Uncarina*, also a member of the Pedaliaceae. Thus the genus agrees with Bignoniaceae only in its woody habit and winged seeds but is allied to Pedaliaceae in the 4-loculed ovary, unilateral disc, simple leaves (these also occur in Bignoniaceae), 5-partite calyx, the presence of mucilage glands, the thin endosperm and the structure of the stomata, stem and petiole. The woody habit though very rare in Pedaliaceae is also found in *Uncarina* and a large corolla with a cylindrical though unspurred corolla-tube is present in *Craniolaria*.

[1]Rec. Trav. Bot. Neer. **39,** 170 (1942).
[2]Ann. Miss. Bot. Gard. **35,** 123 (1948).

When the pros and cons of the above diagnosis are considered, I am of the opinion that the weight of evidence is for the retention of *Sesamothamnus* in the Pedaliaceae, and there is no good reason for transferring the genus to the Bignoniaceae.

Sesamothamnus gurichii (*Engl.*) *E. A. Bruce* comb. nov.

Sigmatosiphon gurichii Engl. in Engl. Bot. Jahrb. **19**, 151 (1894).

Engler separates *Sigmatosiphon* from *Sesamothamnus* on the following characters :—Absence of a spur, equal thickening at the base of the ovary (i.e. a symmetrical disc fused with the ovary) and a possible difference in pollen structure.

In 1894 when Engler described the genus *Sigmatosiphon* there was only one species of *Sesamothamnus* for comparison. Since that date six further species of *Sesamothamnus* have been recorded, though one, *S. seineri* Engl.[3] from Bechuanaland is only represented by a name, a habit photograph and a very incomplete description and so cannot be considered validly published. In the light of this additional knowledge the relationship between *Sigmatosiphon* and *Sesamothamnus* has been re-examined.

Sesamothamnus lugardii N. E. Br. from Bechuanaland, South-West Africa and the northern Transvaal has a very short spur and disc which is inconspicuously asymmetric.

Three different collectings of dried material of *Sigmatosiphon gurichii* Engl. from South-West Africa have been examined in addition to two collectings of spirit material including flowers, fruits and seeds presented by Mr. H. Kinges. In all cases a very definite gibbosity near the base of the corolla-tube was observed and the disc though normally equal is in some cases slightly asymmetric. The capsules and seeds are practically identical with those of *Sesamothamnus lugardii* and pollen of the two genera has also been examined and found to be similar. In view of these findings I am of the opinion that these two genera cannot be separated, the species *S. lugardii* providing a link between those species with a long spur and the gibbosity present near the base of the tube in *Sigmatosiphon*.

It is interesting to note that in some material of *Sigmatosiphon* on loan from Zurich, Schinz was also of this opinion and had written the combination *Sesamothamnus gurichii* (Engl.) Schinz on two sheets, though this does not appear to have been published. He even suggested that the species was synonymous with *Sesamothamnus lugardii* N. E. Br. I do not agree with him on this point, as although the two species are closely allied they can be distinguished : *S. lugardii* by the presence of a short spur, whereas *S. gurichii* possesses only a prominent gibbosity. It is possible that *S. seineri* Engl. may be identical with *S. lugardii* N. E. Br. as both species come from the same area, but as no material of the former is available this can only be put out as a suggestion.

Sesamothamnus rivae *Engl.* in Ann. Ist Bot. Rom. **7,** 30 (1897).

S. erlangeri Engl. in Engl. Bot. Jahrb. **32,** 113 (1902).

S. smithii Bak. ex Stapf in Fl. Trop. Afr. **4** (**2**), 568 (1906).

[3]Engl. Pflw. Afr. **1** (**2**), 586, t. 28, 2 (1910).

The type of *S. rivae*[4] (*Ruspoli & Rivae* 1657) has been examined and the capsule and seeds agree very well with those of *S. smithii*. Unfortunately the type of *S. erlangeri* (Ellenbeck 1166) was destroyed in the Berlin Herbarium during the last war and it has not been possible to trace any duplicates.

Chiovenda has placed material collected by Paoli and Stefanini in Somaliland, originally named *S. erlangeri*, under *S. rivae* and also includes *S. erlangeri* as a synonym of *S. rivae* in his Flora Somala II. I have examined the material collected by Paoli and Stefanini and cannot separate it from *S. rivae* and have therefore reduced both *S. erlangeri* and *S. smithii* to synonymy.

The name *S. smithii* Bak., though first mentioned in Engler & Prantl's Pflanzenfamilien in 1895 was not validly published until 1906, as there was no accompanying description in the earlier work.

Pterodiscus Hook.

Pterodiscus angustifolius *Engl.* in Engl. Bot. Jahrb. **19,** 155 (1894) ; Fl. Trop. Afr. **4** (**2**), 545 (1906).

Pedaliophyton busseanum Engl. in Engl. Bot. Jahrb. **32,** 111, t. 5 (1902).

Pedalium busseanum (Engl.) Stapf in Fl. Trop. Afr. **4** (**2**), 540 (1906).

Tanganyika Territory. Southern Province, Kwa-Mbaramula, near the Ruvuma River, Feb. 1901, *Busse* 1046. Lake Province, Mwanza District, Magu-Kagehi, Nov. 1885, *Fischer* 462. Massanza Isl., Bujingwa, 1300 m., 20 Nov. 1951, *Tanner* 482. Shinyanga District, Seseku & Mhumbo Valleys, 1250 m., 11 Jan. 1937, *B. D. Burtt* 6430. Seseku Mbuga, 1200 m., 7 Jan. 1932, *B. D. Burtt* 3520. Shinyanga, *Koritschoner* 2242 ; Jan. 1933, *R. D. Bax* 296.

Engler in describing his new genus *Pedaliophyton* relates it to both *Pterodiscus* and *Pedalium*, separating it from these on the fruiting character.

Stapf transfers the genus to *Pedalium* amending the description of this genus to include fruits without conical spreading spines at the base of the angles. He had apparently only seen the Busse specimen and had had no extra material for examination.

There are now five different collectings of '*Pedaliophyton busseanum*' in the Kew Herbarium with good flowering and fruiting material and excellent collectors' notes. These show that the plant is not an annual but a perennial with a swollen basal stem and has fruits with a narrow sometimes inconspicuous wing somewhat approaching those of *Pterodiscus speciosus*. These two characters are not found in *Pedalium* but are common to the genus *Pterodiscus* and there is little doubt that the species belongs here.

Pterodiscus angustifolius Engl. was described without fruits and only a leaf and flower from the type have been examined. The rather characteristic leaves of the species and the size, colour and structure of the flower

[4]The type numbers of *Sesamothamnus rivae* Engl. and *Pterodiscus ruspolii* Engl. have been inadvertently interchanged in the original descriptions in Ann. Ist. Bot. Rom. l.c. These should read :—
S. Rivae Engl. Ogaden near Karoul (Riva 1657).
P. ruspolii Engl. Daua near Hamae (Riva 1089).

agree well with the material of '*Pedaliophyton busseanum*' and the author of this note is of the opinion that the two are synonymous.

With the exception of Busse's specimen from the Ruvumu river on the Tanganyika-Portuguese East African border all the material examined is from the Lake Province south of Lake Victoria and appears to be locally common in the Shinyanga District. It is strange that material has not been recorded from intervening localities.

P. kellerianus *Schinz* in Bull. Herb. Boiss. **4,** 453 (1896) ; Fl. Trop. Afr. **4** (**2**), 543 (1906).

P. heterophyllus Stapf in Fl. Trop. Afr. l.c. 546.

Somaliland. Abdullah, 1891, *Keller* 114 (syntype in Z-Herb. Schinz !) Tujusteppe, 1891, *Keller* 115 (syntype in Z-Herb. Schinz !). Without locality, *James* & *Thrupp* s.n. (holotype of *P. heterophyllus* in K. !) Dohoder, halfway between Erigavo and Burran, 1300 m., 7 Oct. 1941, *Peck* 237 ! :— This plant will only grow on gypsum soil but is to be found anywhere in this medium. It is grazed only by goats but children eat the root, which tastes neither bitter nor sweet, but like water.

In the Flora of Tropical Africa the two species *P. kellerianus* and *P. heterophyllus* were separated on the fact that the leaves were homomorphic in the former and heteromorphic in the latter. *P. heterophyllus* consists of only one specimen in which the two pairs of basal leaves are more or less elliptic with undulate margins, whereas the upper pairs are very narrowly lanceolate and either entire or tending to be pinnately lobed. *P. kellerianus* consists of several specimens, in which the leaves are narrowly lanceolate and normally conspicuously pinnatifid, though there are some which are almost entire ; unfortunately the basal leaves are missing so their shape is not known. The indumentum and the size and shape of the flower and the general aspect of the two species appears to be very similar and in my opinion they are synonymous.

P. ruspolii *Engl.* in Ann. Ist. Bot. Rom. **7,** 31 (1897) ; Fl. Trop. Afr. **4** (**2**), 544 (1906).

P. welbyi Stapf in Fl. Trop. Afr. **4** (**2**), 544 (1906).

P. somalilensis Bak. l.c.

Somaliland. Daua, near Hamae, 26 April 1893, *Riva* 1089 (syntype in FI. !). Sole, Daua, 16 April 1893, *Riva* 1101 (syntype in FI. !). Harradigit, April, *James & Thrupp* s.n. (holotype of *P. somalensis* in K. !).

Kenya. Northern Frontier Province, River Turkwel, SW. of Lake Rudolf, April–May 1898, *Capt. Welby* s.n. (holotype of *P. welbyi* in K. !).

The types of the above three species have been examined in addition to a wide range of material from Kenya and Somaliland. There is considerable variation in the size and shape of the leaf and the length of the petiole. The type of *P. somaliensis* has large, broad, shortly petiolate leaves similar to those of *Riva* 1089, one of the type numbers of *P. ruspolii* and the majority of Somaliland specimens are of this form, though there are a few exceptions with smaller longer petiolate leaves comparable to the majority of specimens from Kenya. The type specimen of *P. welbyi* is very similar to *Riva* 1101, the other type number of *P. ruspolii*.

I am of the opinion that the material, though variable can best be treated as a single species, as although the extremes appear very different, there are intermediate connecting forms. I have therefore reduced both *P. welbyi* and *P. somaliensis* to synonymy.

Dicerocaryum Boj.

Dicerocaryum zanguebarium (*Lour.*) *Merrill* in Trans. Ann. Phil. Soc. **24** (**2**), 355 (1935).

Martynia zanguebaria Lour., Fl. Coch. 386 (1790).

Dicerocaryum sinuatum Boj. in Ann. Sci. Nat., Sér. 2, **4,** 269, t. 10 (1835).

Pretrea zanguebaria (Lour.) Gay ex DC., Prodr. **9,** 256 (1845).

Dr. Merrill in the above publication is the first author to show that *Pretrea* Gay was not validly published. The Flora of Tropical Africa and other authors mentioned therein were therefore incorrect in using the name *Pretrea*. It is interesting to note that Bojer described his new genus *Dicerocaryum* independently and did not associate it with *Martynia zanguebaria* Lour. Another point of interest is brought forward by Gay in his manuscript[6] notes, where he mentions that Lourerio's plant did not come from Zanzibar but was collected near Mozambique Island, on what was then known as the Zanzibar Coast, about latitude 15° S. At a later date he adds the following note :—" These notes were written in 1824 and at that time I was going to make a new genus of *Martynia zanguebaria* under the name *Pretrea*. This genus remained unpublished till 1836. It has been published by Bojer in Ann. Sci. Nat. **4,** 268, t. 10 (Nov. 1835 recd. 15 Feb. 1836). The author (Bojer) did not know that this plant had already been mentioned by Loureiro. He gave it the name *Dicerocaryum sinuatum*. My genus *Pretrea* had already been announced under this name in 1824 [Ann. Sci. Nat. **1,** 457 (1824)] and also in Linnaea **7,** 4 (1832)." Gay thus makes it quite clear that he accepts Bojer's name *Dicerocaryum sinuatum* for what was to have been his *Pretrea zanguebaria*. There is an excellent drawing of *Pretra* (probably Lourerio's plant) written up in Gay's handwriting and signed by the artist T. G. Prêtre 1824, so presumably this is the origin of the generic name.

The first generic description of *Pretrea* is to be found in Meisner, Gen. Pl. 298 (1836 1843) and the first use of the binomial in DC. Prodr. **9,** 256 (1845). Apparently Decaisne had some doubts as to the validity of *Pretrea* as he gives this note in Duch. Rev. Bot. **1,** 517 (1846), where he describes three species :—" I have hesitated for a long time in my choice of a generic name for the three last named species. But after I made certain that the plant described by Loureiro under the name *Martynia zanguebaria* had an identical fruit to that of *Dicerocaryum* of Bojer, I decided to follow the nomenclature of the Prodomus regretting however that Gay did not describe the genus *Pretrea* in 1824 . . . . . " Thus Decaisne adopts the name *Pretrea* though he does not seem too happy about it.

In spite of these ' pointers ' by both Gay and Decaisne, it was not until 1935 that Merrill cleared the matter up and made the new combination *Dicerocaryum zanguebarium* (Lour.) Merrill for the plant which had been known for so long as *Pretrea zanguebaria* Gay.

[6]Several volumes in the Library at Kew.

Josephinia Vent.

Josephinia africana *Vatke* in Linnaea **43,** 541 (1882).

Pretreothamnus rosaceus Engl. in Engl. Bot. Jahrb. **36,** 228 (1905) ; Stapf in Fl. Trop. Afr. **4** (**2**), 565 (1906).

P. africanus (Vatke) B. Fedtsch. in Bull. Jard. Imp. Bot. Pierre **15,** 404 (1915).

The genus *Josephinia*, named in honour of the Empress of France, was described by Ventenat in Jard. Malm. **67,** t. 67 (1804) and founded on the single species *J. imperatricis*. This was raised from seed brought back by Captain Hamelin from New Holland (Australia) and flowered in the Malmaison Gardens near Paris in the summer. It is difficult to determine the exact locality of this type species as Captain Hamlein's voyage in the Naturaliste round the north of Australia included calls at many places and islands off the coast as well as Timor and Java. J. Gay in his manuscript notes on the genus *Josephinia* lends emphasis to the fact that the *locus classicus* is in Australia itself as in separating out two varieties of *J. imperatricis* he makes the following geographical citations :—

α *microphylla* : Habitat in insula Timor (*Gaudich*) in Java (*Leschen.*) et in Nova Hollandia intertropica (Brown).

β *macrophylla* : Habitat in Nova Hollandia (*Vent.*), in Novae Hollandiae ora occidentali (navarch *Baudin*, secundum R. Brown).

Thus he regards Ventenat's specimen as coming from New Holland (Australia) in contra distinction to those of Gaudich from Timor and Leschenault from Java.

During the next 60 years three further species of *Josephinia* were described from N. Australia and the Malay Islands (*J. grandiflora* R. Br., *J. celebica* Bl. & *J. eugenia* F. Muell.) but it was not until 1877 that the first African species was discovered by the German botanist, Hildebrandt, near the Tsavo river in the Teita District of Kenya. This was described by Vatke in 1882 under the name *Josephinia africana* and had the typical woody, subglobose, indehiscent spine-covered fruit of the genus but differed in having 3 (not 1) ovules in each compartment.

In 1918 another NW. Australian species, *J. papillosa* W. V. Fitzg. was described and this completes the number of species to date. Backer in Flora Malesiana[7] reduces *J. celebica* and *J. grandiflora* to *J. imperatricis*, so only 3 Australaisian species are now recognised.

In 1905 a new genus *Pretreothamnus* was described and figured by Engler. This was based on the single species *P. rosaceus* from Jeroko, Boran, Somaliland collected by Ellenbeck. Unfortunately this plant was devoid of fruits, so it was difficult to give any accurate generic relationship. Engler, very wisely, states that without fruits it is impossible to give an exact affinity but suggests that there is some likeness to *Pretrea* in the leaf-shape and to *Josephinia* in the 4-loculed ovary.

A year later, in 1906, Stapf includes the genus *Pretreothamnus* in his revision of the Pedaliaceae for the Flora of Tropical Africa but does not mention *Josephinia*. In a footnote to *P. rosaceus* he says that the general appearance of the plant, as figured by Engler, points to a very close

[7]Fl. Mal., Ser. 1, **4** (**3**), 218 (1951).

relationship between it and *Ceratotheca* and *Pretrea*, although there seems to be no indication of central spines or lateral horns on the ovary. It is unlikely that Stapf saw Ellenbeck's specimen as he does not mark it with an exclamation mark in his citation.

Pilger and Krause in Engler & Prantl's Nachtrage[8] publish a description of *Pretreothamnus* and follow Engler in placing it between *Pretrea* and *Josephinia*, but do not mention the species *Josephinia africana*. It is strange that this has been so constantly overlooked in all the African literature.

It was a Russian botanist, B. Fedtschenko[9], who, a year later, published an article linking up the two genera. He states that after a detailed study of Vatke's diagnosis of *Josephinia africana* and Engler's description and figure of *Pretreothamnus rosaceus* he had come to the conclusion that they were one and the same plant. The author of this note entirely agrees with this statement.

Fruiting material of plants from three different localities in Kenya have been examined and all have the conspicuous spiny fruits of the Somaliland *Josephinia africana*. This additional knowledge emphasises Fedtschenko's statement that the two names refer to the same plant, he then goes on to draw the following conclusions :—

(1) *Josephinia* is not found in Africa.

(2) Engler's name for the genus (*Pretreothamnus*) should be retained in nomenclature.

(3) The specific name given by Vatke should also be retained.

(4) The correct name of this plant will be *Pretreothamnus africanus* (Vatke) B. Fedtsch. comb. nov.

From the above points it appears that Fedtschenko considers *Pretreothamnus* and *Josephinia* to be distinct genera although he brings forward no evidence to substantiate this.

Seventeen years later Chiovenda[10], unaware of Fedtschenko's work, independently comes to the conclusion that *Josephinia africana* Vatke and *Pretreothamnus rosaceus* Engl. are one and the same plant. He, however, retains the name *Josephinia africana*, reducing *P. rosaceus* to synonymy. He does not give any concrete reasons for this reduction, though he adds the following note :—

" I don't think that this plant can be separated from the Australian genus *Josephinia*, to which Vatke in 1882 had referred it, from that time to this no one has paid attention to this name ".

The author of this note agrees with Chiovenda in retaining the African species in *Josephinia* and puts forward the following reasons for this claim.

The genera within the family Pedaliaceae are for the most part very similar in their floral appearance, though they can be easily distinguished by their fruits. There is little doubt that the fruits of the Australasian species of *Josephinia* are outwardly almost indistinguishable from those of *J. africana*. The following floral characters are also similar :—the

[8]Engl. & Prantl. Nachtr. Erganz. **3,** 283 (1914).
[9]Bull. Jard. Imp. Bot. Pierre **15,** 404 (1915).
[10]Fl. Somala **2,** 344 (1932).

elongate lower lobe of the corolla, the oblong parallel anther-cells with gland-tipped connective, and the circular thickened disc. The one and only point of difference appears to be the number of ovules in each loculus of the ovary ; in the African species there are three, whereas in the Australasian species there is only one. In the opinion of the author of this note, this alone is not a sufficient reason for separating the two genera. A comparable case of such variation can be found within the family in the genus *Pterodiscus*, where the number of ovules in each cell of the ovary varies from 1 12. In the face of this knowledge the case for retaining the African species in *Josephinia* and reducing *Pretreothamnus* to synonymy is overwhelming. In conclusion a few words on the distribution of the genus. This is admittedly rather unusual though other more or less comparable cases do occur.

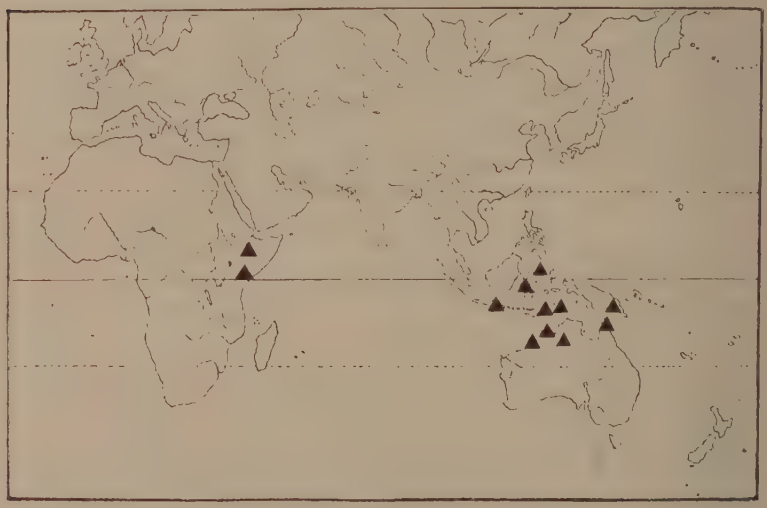

FIG. 1. Distribution of the genus Josephinia.

There are four species in the genus *Josephinia*, one fairly widespread occurring in NNE. Australia and E. Malaysia (*J. imperatricis*), two rather localized in NW. Australia (*J. eugenia* and *J. papillosa*) and one common to the dry parts of Kenya and Somaliland (*J. africana*). All these areas have fairly similar climatic conditions, hot and dry with only a small seasonal variation in temperature, long periods of drought and the rainfall occurring in more or less tropical outbursts. The rainfall stations in Australia are far apart so it is difficult to obtain accurate information about its measurements in the out of the way localities where *Josephinia* occurs, but as far as can be ascertained the genus does not occur in areas of high rainfall. It is interesting to note that *Josephinia* definitely avoids the wetter parts of the Malay Islands, which are affected by the South West monsoons and is only to be found in the hot dry coastal plains of Java, the Celebes and those Islands protected from the monsoons by the continent of Australia. It is of course possible that in very early times the genus did occur in parts of India but was driven out by the unsuitable climate. It is difficult to come to any very reliable conclusions to account

for this unusual discontinuous distribution. It appears that the African species, having the greater number of ovules in each loculus of the ovary, should be regarded as the most primitive member of the genus. Does this suggest that *Josephinia* originated in Africa and spread eastwards to the S.E. Malay Islands and N. Australia? Or is the genus a very ancient one which arose on some older land mass, which has since split up so that there has been parallel development? There is not sufficient evidence to support or deny either supposition so the birth of *Josephinia* must be left shrouded in mystery.

One final point, it is interesting to note that the distribution of the Baobab tree (*Adansonia*) though not identical with *Josephinia* is very similar to it. This is a genus of the dry savannah country consisting of several species. One species is common to tropical Africa and the northern Transvaal, two occur in northern Australia and several in Madagascar. Here we have the intervening link of Madagascar which is absent in the distribution of *Josephinia*.

Sesamum L.

The genus *Sesamum*, since its first publication, has been divided by various authors into different genera and sections and it is the object of this short note briefly to review these past steps and to make some recommendations for the future.

Sesamum[11] was founded on the two species, *S. indicum* L. and *S. orientale* L., the latter being now considered as a synonym of the former.

In 1839 *Endlicher*[12] divided the genus into two sections :—

Sect. 1. Eusesamum Endl. : Seeds compressed, emarginate (*S. indicum* L.)

Sect. 2. Sesamopteris Endl. : Seeds angled, surrounded by a membraneous margin . . . . . (*S. pterospermum*[13] R. Br.)

A few years later Professor Bernhardi[14] in his paper on ' The Genera of the Sesameae ' discusses the relationship between *Ceratotheca* and *Sesamum* and puts forward the following proposals for the division of *Sesamum*. He considers that there is so much difference between the species of *Sesamum* in the persistence of the calyx and in the construction of the fruit and seed that it would be advisable to divide it into at least three genera and he goes on to propose the following :—

I. Sesamum L. : Containing the true species of the genus and possessing the following salient characters :—

Calyx persistent. Seeds dorsally compressed, margined, wingless, slightly convex on the upper and lower faces with a number of lines in the centre. (*S. orientale* L., *S. indicum* L.).

II. Simsimum Bernh. : (Derived from the arabic name of *S. rostratum* Hochst.). Calyx deciduous. Capsule linear-oblong narrowed downwards and narrowed into a beak upwards, two-lobed, four-grooved.

[11]Linn. Sp. Pl. ed. **1,** 634 (1753).
[12]Endl. Gen. Pl. 709 (1839).
[13]*S. pterospermum* R. Br. in Salt Abyss. App. 64 (1814) nomen.
[14]Linnaea **16,** 29 (1842).

Seeds somewhat obliquely overlapping, brown, rugose, winged at the base and apex. The only species is *S. rostratum*.

III. Gangila Bernh. : (Taken from an African synonym of *Sesam*). Calyx deciduous. Capsule oblong, acuminate, 2-lobed, 6-grooved. Seeds more or less horizontal in each loculus similar to the preceding except for a wing completely surrounding the seed. The only species is *G. pentaphylla*.

Having described the above three genera Bernhardi is apparently at a loss to know where to place the following species :—*S. pterospermum* R. Br., *S. alatum* Thonn. and *S. radiatum* Schumach. Meisner and De Candolle included these in the section *Sesamopteris* Endl. but Bernhardi seems unable to decide in which of his three genera this section should be placed and is also unable to place the following species :—*S. laciniatum* Willd., *S. luteum* Retz and *S. prostratum* Retz. In view of the number of species unaccounted for his work is not of great value.

The following year, Endlicher [15], presumably having seen Bernhardi's work, created a third section for *Sesamum* to bring his work into line with Bernhardi's :—

Sect. 1 Eusesamum Endl. (*Sesamum* L.)

Sect. 2 Simsimum Endl. (*Simsimium* Bernh.)

Sect. 3 Sesamopteris Endl. (*Gangila* Bernh.)

In 1845 De Candolle [16], to some extent combining Endlicher's and Bernhardi's arrangements, divides the genus *Sesamum* into two genera on the character of the winged and wingless seeds, and then further subdivides the genus containing the winged seeds into two sections :—

I. Sesamum L. (sect. *Eusesamum* Endl.) Calyx persistent. Seeds wingless. (*S. indicum* and vars. *S. lacinatum*, *S. luteum*, *S. occidentale*, *S. brasiliense*).

II. Sesamopteris DC. (*Sesamum* Sect. *Sesamopteris* Endl.) Calyx deciduous. Seeds compressed, winged.

Sect. 1. Simsimum A. DC. (*Sisimum* Bernh. and *Sesamum* Sect. *Simsimum* Endl.).

Capsule 4-angled. Seeds rugose. (*S. radiata*, *S. alata*).

Sect. 2. Gongyla A. DC. (*Gangila* Bernh., *Sesamum* sect. *Sesamopteris* Endl.).

Capsule 2-lobed, lobes 3-grooved. Seeds not rugose ? (*S. pentaphylla*).

In the above arrangement De Candolle has accounted for most of the species omitted from Bernhardi's classification, though he does not place either *S. pterospermum* or *S. prostratum*, though the former is mentioned as only a possible *Sesamopteris* species in spite of the fact that Endlicher founded his section *Sesamopteris* on this species.

In 1876 Bentham & Hooker[17] in the Genera Plantarum recognise only the one genus *Sesamum* and divide this into three sections :—

[15]Endl., Gen. Pl. Suppl. **3,** 79 (1843).
[16]DC., Prodr. **9,** 249 (1845).
[17]Gen. Pl. **2,** 1059 (1876).

Sect. 1. Sesamoptypus Benth. & Hk. f. (*Sesamum* L., *Sesamum* sect. *Eusesamum* Endl.).

Erect, annual herb. Calyx often, not always persistent. Seeds compressed, smooth, wingless (5 or 6 species).

Sect. 2. Sesamopteris Endl. (*Simsimum* and *Gangila* Bernh., *Sesamopteris* DC. excl. *S. radiata*).

Erect annual herbs. Calyx often not always deciduous. Seeds foveolate, winged at base and apex or all round (2 species).

Sect. 3. Chamaesesamum Benth. and Hook. f.

Prostrate perennial herb. Seeds wingless, foveolate (2 species).

Bentham & Hooker's Section *Sesamotypus* corresponds to Sect. *Eusesamum* Endl. and the Sect. *Sesamopteris* is comparable to Endlicher's concept of this and also to De Candolle's genus *Sesamopteris* excluding the species *S. radiatum*, which does not have winged seeds. Their third section has been created to accommodate the two Indian species with a prostrate habit (*S. lacinatum* and *S. prostratum*), the former species was placed by De Candolle under *Sesamum* L. but the latter species has not been accounted for by previous authors.

In 1895 Stapf, in Engl. & Prantl, Pflanzenfamilien[18], more or less follows the above arrangement in dividing *Sesamum* into three sections though his arrangement of the species within the section is different, as he includes only *S. indicum* in his conception of the section *Sesamotypus*, whereas Bentham & Hooker include five or six species ; again under section *Sesamopteris* Endl. he includes all the other African species including *S. radiatum* which Bentham & Hooker definitely exclude.

Sect. 1. Sesamoptypus Benth. & Hook. f.

Capsule dehiscent almost to the base. Seeds compressed, smooth, not winged on the margin. Annual small plants. (One species, *S. indicum*, with many cultivated forms.)

Sect. 2. Sesamopteris Endl.

Like above but seeds narrowly winged at the margins and mostly radially rugose. Here belong all the African species. (*S. radiatum* is found in many parts of Africa . . .)

Sect. 3. Chamaesesamum Benth. & Hook. f.

Capsule only dehiscent at tip, seeds wingless, foveolate. Perennial prostrate herbs. (Two closely allied species from India.)

Later in the Flora of Tropical Africa,[19] where seventeen species are recorded, Stapf revises his ideas and though still keeping to the same sectional names he changes their concept and re-arranges the species so that only three are included under Sect. *Sesamopteris* and the remaining fourteen appear under Sect. *Sesamotypus* :—

[18]Pflanzenfam. **4** (**3B**) : 262 (1895).
[19]F.T.A. **4** (**2**) 550 (1906).

Sect. 1. Sesamotypus Benth. & Hook. f. emend. Stapf.

Plants distinctly (though sometimes sparingly) pubescent or long-hairy to villous. Leaves undivided, rarely the lower 3-foliolate or 3-partite. Seeds with more or less acute margins, rarely with a narrow membraneous rim (*S. antirrhinoides*) ; faces rugose or smooth. (All the tropical African species with the exception of the three mentioned below).

Sect. 2. Sesamopteris Endl. emend. Stapf.

Plants glabrous (apart from the mucilage glands) or with few microscopic adpressed hairs on the youngest parts. Leaves (at least the lower and intermediate) 7–3 foliolate or 7–3 partite. Seeds broadly winged (excepting *S. schenckii*), faces muricate-foveolate (*S. alatum*, *S. schenckii and S. capense*).

There appears to be no absolute distinction between the above two sections as in both cases the leaves can be simple, 3-partite or 3-foliolate and the seeds wingless or narrowly winged. Taking, for example, the case of *S. schenckii*, a species very closely allied to *S. capense* and only differing from it in having wingless seeds. It is obvious that if sections are maintained these two species must occur in the same section. If this is done an exception is immediately created to the main differential sectional character (i.e. seeds winged or wingless). Other examples of a like nature can be quoted. In view of the unsatisfactory limits of these and previous sections of the genus *Sesamum*, I am of the opinion that little can be gained in maintaining them.

S. schenckii *Aschers.* in Verhandl. Bot Ver. Brandenb. **30** : 184 (1888) ; Fl. Trop. Afr. **4** (**2**), 560 (1906).

S. grandiflorum Schinz in Bull. Herb. Boiss. **4,** 453 (1896).

S. gibbosum Brem. & Oberm. in Ann. Tvl. Mus. **16,** 434 (1935).

S. capense Burm. f. var *grandiflorum* Stapf in Fl. Trop. Afr. **4** (**2**), 561 (1906).

Southern Rhodesia. Bulawayo, Jan., *T. Gardner* s.n. !

Bechuanaland. Gemsbok, 1 May 1930, T.M. 28963 (syntype of *S. gibbosum* in TRV !) ; Kwebe Hills, 11 Feb. 1898, Lugard 172 ! :— erect annual to 1·5 m., flowers various shades of dull mauve.

South West Africa. Damaraland, Tsama Valley, at Kuwosis in the Khan Valley, 2 Oct. 1885, *Schenck* 431 (syntype of *S. schenckii* in Z-Herb. Schinz !) ; Ameib, at the foot of the Erongo Mts., *Bleck* 34 (syntype of *S. schenckii* in Z-Herb. Schinz !) ; Nauas, Apr. 1891, Fleck 274a (syntype of *S. grandiflorum* in Z-Herb. Schinz ; iso-syntype in K !).

Transvaal. Rustenburg, Buffelspoort 668, 4 Mar. 1927, Turner 1 !

The syntypes of *S. schenckii* from the Schinz Herbarium at Zurich, those of *S. gibbosum* from the Transvaal Museum at Pretoria and the iso-syntype of *S. grandiflorum* at Kew, have been examined and compared.

The material of *S. schenckii* and *S. gibbosum* consists of good leaves, flowers and fruit but *S. grandiflorum* unfortunately has no fruits. The leaves in all three species are both simple and tripartite and in both

S. schenckii and *S. grandiflorum* there are leaves which are up to 7-partite. The buds in all three are conspicuously pilose and the expanded flowers rather larger than in *S. capense* Burm. f., to which this species is very closely allied.

The seeds in *S. schenckii*, though normally wingless in some cases have a very small bi-lobed wing at the apex comparable to *S. gibbosum*.

I do not think this slight difference is sufficient for specific distinction and in my opinion the three species are synonymous. It would be interesting to compare further material of seeds and note what variation occurs in the development of the wing.

Royal Gardens.*—The author has gathered together in this volume a collection of over a hundred excellent black and white photographs of the Royal Gardens at Buckingham Palace, Windsor Castle, Sandringham House, the Palace of Holyroodhouse and Balmoral Castle.

From the foreword we learn that the late King George VI took a very keen interest in the design, construction and improvement of the Royal Gardens which reached a high standard of development during his reign. Although this is mainly a book of photographs, Mr. Lanning Roper in the few pages devoted to his short but interesting account of the Gardens, traces their history and describes their development over a long period. The photographs depict many varied and delightful scenes of dignity, simplicity and charm which will appeal to the many who derive pleasure and enjoyment from the beauty of gardens.

H. S. Marshall.

South Australian Plants.—†J. M. Black's *Flora of South Australia* has long since established itself among the most valuable items in the library of anyone seriously interested in the Australian flora. The appearance of a further part (Part III) of the second edition of this most useful work is therefore all the more welcome. It is to be regretted that the author did not live to see this new edition completed but we understand that the remainder of the book can be prepared from the very full notes left by Mr. Black.

The present volume, which deals with families 69–89 (Callitrichaceae –Plumbaginaceae) maintains the high standard of production of the first edition and of the earlier parts of the present edition. It also includes a short biographical account and photograph of the author together with additions and corrections to the families dealt with in parts I and II. We shall look forward eagerly to the appearance of Part IV which, it is hoped, will be published without undue delay.

* Royal Gardens. By Lanning Roper. Pp. 96. London : W. H. & L. Collingridge Ltd. Price 15/-.

† Flora of South Australia, ed. 2, Part III, by J. M. Black. Government Printer, Adelaide, 1952. Price 8/6.

Dispersal in Fungi.*—The diverse methods of spore liberation in fungi offer a fascinating field of study which Professor Ingold has explored with considerable success. Hence the first half of this little book is occupied by a detailed and clearly illustrated account of the mechanisms involved, based largely on the author's personal observations. The second half deals with dispersal of the liberated spores, by air, insects, other animals including man, and by water. Prof. Ingold evidently believes it is possible to describe biological phenomena in plain English and without coining new polysyllabic names for each kind of mechanism recognised. This unorthodox outlook, expressed in his concise and lucid style, makes the book easy and pleasant to read and enables one to recommend it gladly to biologists in general, however ignorant they may be of mycology. Another attractive feature which helps to make the text readable is the omission of authorities for specific names. Instead of cumbering the text these are cited as an appendix in an alphabetical " List of Fungi Giving the Authority for Each Species ". Unfortunately this has evidently been compiled from various published lists without attempting a consistent method of citation or selection of legitimate names, e.g. *Mitrula paludosa* Fr. ex Fr. is the legitimate name for " *M phalloides* [Bull.] Chev." of the text. "Bond." appears indiscriminately for Boudier and Bondarzew. The numerous excellent line drawings are supplemented by 8 half tone plates from remarkably fine photographs. Plates V and VI are particularly noteworthy as capturing something of the jewel-like beauty displayed by some minute fungi at quite low magnifications.

R. W. Dennis.

Flora of West Virginia.†—This is the first part of a flora that might be described as an up-to-date " Bentham and Hooker " for West Virginia. In other words, it is a compact flora with descriptions, keys, and black and white drawings, intended to serve as an introduction to the taxonomic study of the vascular plants of the State. The dichotomous keys appear to be well constructed and the descriptions concise and adequate. The drawings are suitably placed in that, as far as possible, they face the relevant part of the text.

It is stated that about 2000 species are found growing without cultivation within the boundaries of the State. Two or three more fascicles will be required to complete the work. In the present part the vascular cryptogams and monocotyledons are described and figured. In addition to native species, well established introduced plants are included. The general format is pleasing and the Flora should be of great use both to local botanists and to anyone concerned with the study of plant ranges in North America.

W. B. Turrill.

* Dispersal in Fungi. C. T. Ingold. Oxford University Press. Pp. viii + 197, 1953. 18/-.

† Flora of West Virginia (Part I), P. D. Strausbaugh and Earl L. Core, West Virginia University Bulletin, Morgantown, W. Virginia, 1952. $1.

TROPICAL AFRICAN PLANTS : XXIV*

Unless otherwise localised, specimens cited are to be found in the Herbarium of the Royal Botanic Gardens, Kew. Abbreviations for herbaria follow Drs. Lanjouw and Stafleu's standardised list published in Index Herbariorum **I** : 106–117 (1952).

Ranunculaceae

Ranunculus oligocarpus [*Hochst. ex*] *A. Rich.*, Tent. Fl. Abyss. **1,** 5 (1847) ; Fl. Trop. Afr. **1,** 10 (1868) ; Ulbr. in Notizbl. Bot. Gart. Berl. **10,** 905 (1930).

Uganda. Karamoja District, Napak, in grass, 2190–2340 m., June 1950, *Eggeling* 5968 (EA) :—flowers yellow.

Kenya. Aberdare Mts., Sattima, in bog, 21 Mar. 1922, *Fries* 2453 (specimen not seen).

Since the publication of " Ranunculaceae " in the Flora of Tropical East Africa, a specimen from Uganda has been received on loan at Kew from the East African Herbarium, which proves to be the above species. Quite independently my attention has been called to the reference (Ulbr. l.c.) to this species having been recorded from Kenya, a reference which, it is regretted, was overlooked when the Flora was being written.

In the key (F.T.E.A. Ran. 13 : 1951) *R. oligocarpus* runs down to the part including *R. raeae* Exell, with which species it agrees in having trilobed or trisect basal leaves, thickened roots and erect fruiting pedicels. It differs, however, in its stems being weak, procumbent or flexuose (not erect), in the flowers being smaller with narrower petals up to 6 mm. (not 8–10 mm.) long, and in the carpels being few (± 10) with very short beaks, as against numerous carpels with long beaks in *R. raeae*.

It is hoped that collectors will keep a look out for this buttercup in these and other similar localities, and if they are lucky enough to find it, collect good material complete with roots. It is at present unrepresented at Kew from the area covered by the Flora.

E. Milne-Redhead.

Turneraceae

Loewia thomasii (*Urb.*) *J. Lewis*, stat. nov. ; a congeneribus lobis calycis tubo subaequalibus, pube ramorum juvenilium foliorum densissime hirsutorum nunquam glandulosa differt.

Turnera ulmifolia L. var. *thomasii* Urb. in Engl., Bot. Jahrb. **25,** Beibl. 60, 11 (1898).

The type gathering, *F. Thomas* 47 (B, holotypus destroyed, K, isotypus!) from Witu, Lamu District, Kenya, remains the only example of this taxon. The isotype clearly shows greater affinity to the E. & N.E. African genus *Loewia* Urb. than to the predominantly American *Turnera* L., and it is especially strange that Urban should have included it in the well-known species *T. ulmifolia* L. He excluded the plant from *Loewia* apparently on account of the indumentum since this feature was mentioned as diagnostic between the genera in the notes on this genus when he

*Continued from **K.B. 1953,** 120 (1953).

described it in Ann. R. Inst. Bot. Rom. **6,** 189 (1897). The young stem, leaves, bracteoles and calyx are indeed densely hirsute, but this character is similarly exceptional in *Turnera*. The two genera are very close but, as *Loewia* is to be retained, partly for reasons of practicality, for the Flora of Tropical East Africa, the above transfer is necessary.

J. Lewis.

Chenopodiaceae

Atriplex farinosa *Forsk.* var. **keniensis** *Brenan*, var. nov. ; a planta typica bracteolis in statu fructifero in medio partis liberae conspicue muricatis vel tuberculatis differt.

Kenya. Mombasa District. Mombasa, in sand very near the sea, Oct. 1929, *Graham* 2166 (K, EA) :—somewhat succulent shrub 1·5 m. high; stems white and brittle ; leaves glaucous ; flowers greenish-yellow, small. Kilifi District. Sabaki [now Galana] R. near Malindi, Oct. 1873, *Kirk s.n.* Kilifi, in sand at high tide mark, 5 Nov. 1945, *Jeffery* K. 380 (K, typus varietatis, EA, isotypus) :—upright, branched, about 1·2 m. high ; leaves light greyish-green ; flowers very small.

All authors dealing with *A. farinosa* in areas outside East Africa agree in describing the fruiting bracteoles as smooth and without tubercles ; this is confirmed by the specimens. Therefore, although Forskål's type-specimen is lacking, it is reasonable to assume that the typical plant—*A. farinosa* var. *farinosa*—was similar, and to separate varietally the Kenya plants. Certain specimens :—Mombasa District, Nyali, 19 Aug. 1948, *Bally* 6365, and Kilifi District, Mtwapa, 6 Oct. 1934, *Mrs. E. H. Ward in C. M.* 6639—are in bud or flower only, but are presumably also var. *keniensis*.

J. P. M. Brenan.

Suaeda micromeris *Brenan*, sp. nov. ; *S. vermiculatae* Forsk. ex Gmel. ut videtur affinis, floribus minoribus, foliis minimis, habitu plerumque prostrato distinguenda.

Herba perennis, ramosissimus, inferne sublignosus. *Ramuli* juveniles graciles, 0·5–0·75 mm. diametro, pallidi, breviter pubescentes, vetustiores tarde glabrescentes, griseo-brunnei, longitudinaliter rimosi ; internodia plerumque brevissima. *Folia* spiraliter disposita, carnosa, viridia, sessilia (juvenilia subsessilia), ellipsoidea vel ellipsoideo-obovoidea (juvenilia oblongo-obovoidea), 0·75–1·7 mm. longa (juvenilia usque ad 2·5 mm.), 1–1·3 mm. lata, a latere visa 0·5–1·25 mm. crassa, glabra, basi apiceque rotundata, supra aliquid applanata. *Flores* luteoli, minimi, axillares, sessiles, hermaphroditi et foeminei commixti ; hermaphroditi 1·5–2 mm. diametro, sepalis ovato-oblongis 1 mm. longis 0·7–1 mm. latis dorso rotundato-convexis, filamentis 0·25–1 mm. longis, antheris 0·7–0·75 × 0·4–0·5 mm., ovario 0·75 mm. alto, basi 0·6 mm. diametro, stigmatibus 2–3 subulato-filiformibus ; foeminei circiter 1 mm. longi et diametro, sepalis circiter 0·5 mm. longis 0·4 mm. latis. *Semina* " verticalia ", 1 mm. alta, 0·7 mm. lata, 0·5 mm. crassa, parum compressa ; testa fere laevis, nigra, nitida.

British Somaliland. Between Las Anod and Hudin, 25 June 1945, *Glover & Gilliland* 1119 (K, typus, EA, isotypus) :—usually prostrate

succulent perennial herb with tiny green succulent leaves ; flowers yellowish : vernacular name " Dinas ".

Italian Somaliland. Between Belet Wein and Mogadishu, dominant plants on salt flats with occasional clumps of trees mixed, including euphorbias, 6 Nov. 1952, *C. F. Hemming* 71 : vernacular name " Danis ".

J. P. M. Brenan.

Salsola dendroides *Pall.* var. **africana** *Brenan*, var. nov. ; foliis, saltem ramorum sterilium, nonnunquam oppositis, a latere visis breviter oblongis vel cymbiformibus, plerumque 1–3·5 mm. longis, 1–1·5 mm. ad perpendiculum crassis, dorso obtuse carinatis, in fasciculos laxiores dispositis differt.

Kenya. Northern Frontier District. Merille, 14 June 1920, *Shantz* 845. Archer's Post, Uaso Nyiro R., in almost pure sand near river, 810 m., 28 Feb. 1935, *D. C. Edwards* 2974 :—shrub. Garissa, on road to Afmadu, 180 m., 28 Dec. 1942, *Bally* 2011 *in C.M.* 12465 :—common fleshy shrub to 1·5 m. high. Between Kulal and Marsabit, in sandy semi-desert, 430 m., 17 Oct. 1947, *Bally* 5669 :—green bush with fleshy leaves. Near Uaso Nyiro, *Mrs. G. Dalton* 7 (EA) :—low-growing spreading bush with woody stem. Garissa road, Kenia–Somalia frontier, in *Acacia tortilis* woodland with *Euphorbia* sp. and *Sansevieria* sp., 5 Aug. 1952, *Hemming* 2 :—clumps up to 1 m. high and in diameter. Turkana District, about 910 m., June 1934, *D. R. Buxton* 1023 :—shrubby. Tana River District, 90 300 m., *Battiscombe* 223 *in C.M.* 13336 :—succulent bush in dry thorn-scrub.

J. P. M. Brenan.

Salsola pycnophylla *Brenan*, sp. nov. ; species habitu perinsignis, ut videtur *S. rubescenti* Franch. et *S. hadramauticae* Bak. comparanda, foliis valde confertis brevioribus, fovea folii fere usque ad laminae apicem prolata, fructibus alis inclusis diametro multo minoribus facillime secernenda.

Frutex humilis 7·5–45 cm. altus, compactus, valde ramosus. *Caules* dense pubescentes, vetustiores lignosi, cortice cinereo subtiliter rimoso obtecti ; internodia ramulorum saltem lateralium brevissima, 1–2 mm. longa, ramorum primarium nonnunquam longiora (usque ad 4 mm.). *Folia* vero alterna, disticha, ramorum lateralium saltem arcte imbricata, ramulum ipsum celantia, parva, rigida, sessilia, latissime amplexicaulia, fere perfoliata, breviter cymbiformia, 3–4 mm. longa, 2 mm. alta (a latere visa), 2·25 mm. lata, dense et brevissime sericeo-pubescentia, apice subacuta, subtus rotundata, supra foveata, fovea fere usque ad apicem laminae prolata margine ciliolata. *Flores* apicem ramulorum lateralium versus axillares, sessiles, ovoidei, circiter 4–4·5 mm. longi, 2·5 mm. lati, utroque flore bracteis duabus foliis similibus sed late scarioso-marginatis medio tantum viridibus 3 mm. longis 2 mm. altis 2–2·25 mm. latis apice obtusis vel subacutis subtenso. *Sepala* 5, ovata, subacuta, 4 mm. longa, 2–2·5 mm. lata, superne appresse sericea, serius paulum infra medium alata, infra alarum insertionem marginibus breviter ciliatis exceptis glabra. *Stamina* 5, filamentis 2–3 mm. longis, antheris 2 mm. longis hastatis. *Ovarium* 1·5–2·5 mm. altum, 1·25–1·5 mm. latum, basi disco membranaceo erecto 0·4 mm. alto circumcinctum, apice in stylum subulato-conicum 1·5 mm. longum breviter angustatum, stigmatibus

duobus 1 mm. longis. *Fructus* circiter 8 mm. diametro, utroque sepalo transverse alato, alis horizontaliter patentibus 3·5-5 mm. latis 1·5-3 mm. longis scariosis multinervatis margine erosis. *Semen* horizontale, circiter 2·25 mm. diametro, testa tenui pallida.

British Somaliland. Erigavo District. Buran, 10°13′ N., 48°47′ E., 990 m., singly over rocky ground, very common, on sides of valley and on hills surrounding valley, 7 Sept. 1929, *Collenette* 41 (K, typus) :—shrub of 45 cm., very compact, of stunted growth ; " flower " [probably fruit intended] crimson ; uncommon at Hormo, common at Karing in Italian Somaliland : vernacular names (Warsangeleh) " Waloh ", (Ishaak tribes) " Habou ". Hubera, 1220 m., stony hills, 11 Oct. 1938, *McKinnon* S 118 :—small bush eaten by camels, sheep and goats : vernacular name " Dinas-ad ". Buran, 1010 m., 7 Oct. 1941, *Capt. E. F. Peck* 232 (K, EA) :—low bush about 7·5 cm. high and 30 cm. in diameter, a salt-bush grazed by sheep, goats and camels ; grows from Buran to the coast in all localities, but not elsewhere : vernacular name " Gulan " (used for various plants). Without locality, *Dr. Andy* Y43 (K, EA).

Italian Somaliland. 30 km. S. of Dusa Mareb, 12 Oct. 1951, *Bond & Pechanic* 40 (EA).

This remarkable-looking plant is outstanding in *Salsola* by its leaves, at least on the lateral shoots, being very short and boat-shaped, imbricate, alternate and distichous. In general appearance there is a similarity to *S. pachoi* Asch. et Volk. from Egypt, but in that species the leaves are opposite and decussate, and the branchlets thus four- not two-angled.

From the description, the plant referred to as " *Salsola* ? " by Chiovenda in Fl. Somala 291 (1929) is probably conspecific. He aptly compared his plant in facies with the South American composite genus *Tafalla*. The subreticulate rugose appearance on the lower surface of the leaves, noted by Chiovenda, seems however, to be an artefact caused by drying. When boiled up the leaves of *S. pycnophylla* are turgid.

The plant referred to as " *Chenopodiaceae*, not determined " by Collenette in Kew Bull. **1931** : 406 (1931) is clearly *S. pycnophylla*.

J. P. M. Brenan.

Hypericaceae

Hypericum keniense *Schweinf.* and its allies.

It has been agreed by various botanists writing on the flora of Ruwenzori that there are two distinct arborescent species of *Hypericum* on the massif apart from *H. lanceolatum* Lam., which as Robyns (Fl. Sperm. Parc. Nat. Alb. **1,** 622 : 1948) states appears to be absent unless one considers, as I do, that its near ally, *H. lanuriense* De Wild., is in fact conspecific with it. Good (Journ. Bot. **65,** 333–4 : 1927) who had comparatively little material available, deals rather unsatisfactorily with this group.

These two species, which I here call sp. A & sp. B, appear to inhabit different altitudinal zones, and have been distinguished by Staner (Bull. Jard. Bot. Brux. **13,** 67 : 1934) as follows :—

Flowers yellow ; petals 20–25 mm. long, 10–15 mm. wide ; grows below 3500 m. altitude . . . . . sp. A.

Flowers red ; petals 30–35 mm. long, 20–22 mm. wide ; grows above 3500 m. altitude . . . . . sp. B.

An additional character for separating these species is that in sp. A the flowers expand fully in anthesis, whilst in sp. B they remain cup-shaped. This character is often quite obvious even after the specimens have been pressed.

They can be distinguished from *H. lanceolatum* and *H. lanuriense* by the venation of the leaves which consists of one or two secondary veins on each side of the midrib arising near the base and running more or less parallel with the midrib for the greater part of the length of the leaf. Occasionally there may be an indistinct secondary vein connecting obliquely the midrib with one of the parallel secondaries, between which there are closely packed resin-canals. In the leaves of *H. lanceolatum* there is normal pinnate anastomosing venation and the resin-canals are interrupted and less densely packed.

Staner (l.c.), Robyns (l.c.) and Dale (Ind. Trees Uganda Prot., ed. 2, 157 9 : 1952) agree in calling sp. A, *H. ruwenzoriense* De Wild. and sp. B, *H. keniense* Schweinf. They all quote *H. bequaertii* De Wild. as a synonym of the latter.

In reviewing this group of *Hypericum* for the " Flora of Tropical East Africa " I have been struck by the apparent absence of any plant with the characters of sp. B from all the other East African mountains. The plant from the highest altitudes on Mt. Kenya, which is now represented at Kew by an excellent gathering made by Gilbert Rogers, has yellow or orange (not red) flowers with petals about 15 mm. wide and which appear to expand fully in anthesis. A fragment of the holotype of *H. keniense* Schweinf., which happily is preserved in the British Museum Herbarium, agrees well with this gathering, which I consider represents that species. This plant fits the above definition of sp. A rather than sp. B, the only point of divergence being that the petals are described as orange.

I am therefore, not able to agree with the nomenclature and synonymy adopted by the above-mentioned authors for the species from Ruwenzori. In my opinion sp. A is *H. keniense* and sp. B is *H. bequaertii*, the former being widely spread on the East African mountains, whilst the latter is restricted to high altitudes on Ruwenzori. *H. ruwenzoriense* therefore should be treated as a synonym of *H. keniense*. It is interesting that neither has been recorded from the Virunga Mts.

E. Milne-Redhead.

Hypericum annulatum *Moris*, Stirp. Sard. 9 (1827).

H. intermedium [Steud. ex] A. Rich., Tent. Fl. Abyss. **1,** 95 (1847).

H. perfoliatum L. var. *annulatum* (Moris) Fiori in Fiori & Paoletti, Fl. Anal. Ital. **1,** 389 (1898).

Whilst working on material of *Hypericum intermedium* A. Rich. at Kew in connection with the preparation of the account of the *Hypericaceae* for the Flora of Tropical East Africa, my attention was attracted to a note by that acute observer, J. Gay, on the sheet from his herbarium of the type gathering of that species, namely *Schimper* 1062. The note, dated 5th October 1843 (which it will be noted was four years before Richard published his description), starts with a brief description of the specimen which is followed by the following :—" His notis planta ad *Hyp. annulatum*

Moris ! (Fl. Sard. I. p. 323, tab. 22) tàm propè accedit, ut in speciem propriam vix accipienda videatur. A Sardoâ enim, quae coram est (ab auctore communicatâ), abyssinica non differt, nisi statura altiore, paniculâ amplâ non depauperatâ, et foliorum dorso punctis nigris carente, margine scilicet solùm punctato (Gay in litt. ad Hochstetterum)." In his MS. notes preserved at Kew he states " His notis planta in *Hyp. annulatum* Moris ! quadrat adeo ut in speciem propriam vix accipienda videatur."

Happily's Gay's sheet of the type gathering of *H. annulatum*, which, together with his herbarium and MSS., was purchased by J. D. Hooker in 1867, is preserved in the Kew Herbarium. Examination of it revealed no character which I would consider to be specific to separate it from *H. intermedium.*

Whilst there was at Kew a fair amount of material of *H. intermedium* from Kenya and a little from Uganda and Tanganyika, the collections from the region around the *locus classicus* in northern Ethiopia were not very extensive. Through the kindness of my friend, Prof. R. E. Pichi-Sermolli, the material of *H. intermedium* from the Herbarium Universitatis Florentinae was sent on loan to Kew, together with material of *H. perfoliatum* L. and two sheets of *H. annulatum* Moris, including the holotype of the latter which was kindly made available by the Director of the Istituto Botanico Università, Torino.

The rich material of *H. intermedium* sent from Italy confirmed my view that the species is extremely variable in a number of characters. In stature it varies from 10 to 75 cm. ; the length of the indumentum on the underside of the leaf from very short and inconspicuous to velutinous ; the inflorescence from 2·5 to 16 cm. long and from few to many flowers ; the black glands on the lower surface of the leaf from few and submarginal to numerous and scattered ; the length of the sepals from 4 to 8 mm.; the black stalked glands towards the base of the bracts from few to a dense mass apparently forming a ring round the stem ; the sepals with or without black dots and dashes on their surface ; the petals with or without black dots, to mention but some of the more obvious characters. In general there seemed to be little if any correlation, but at higher altitudes the species is usually dwarfer and more glandular.

Examination of the type of *H. annulatum* Moris and the other gathering of that species from Sardinia show that there is some variation within the population in Sardinia and that the Sardinian plant falls well within the range of variation found in *H. intermedium* in Africa. That being so, I am obliged to agree with Gay and in fact to go rather further and place all the African material under *H. annulatum*, which is of course a considerably earlier name.

I cannot agree, however, that *H. annulatum* Moris is a variety of the widely spread Mediterranean species, *H. perfoliatum* L., a view held by Fiori (l.c. supra) and other recent writers on the Italian flora.

In the Flora of Tropical Africa, Daniel Oliver reduces *H. atomarium* Boiss. and *H. gracile* Boiss., both described from plants from Asia Minor, to the synonymy of *H. intermedium.* Whilst I agree that *H. atomarium* Boiss., restricted in the sense of Bornmuller (Magyar Bot. Lap. **19,** 88 : 1910) to the plant from Asia Minor, is conspecific with *H. gracile* Boiss.,

which Boissier himself later placed as a variety of *H. lanuginosum* Lam., I cannot agree that they are synonymous with *H. intermedium* and *H. annulatum* ; *H. gracile* and *H. atomarium* have a more densely cymose inflorescence, sepals which are shorter and have shorter glandular teeth, and flowers which are well under 1 cm. long when closed. There are, however, certain plants from the Balkans which approach *H. annulatum* very closely indeed. Any student of the Balkan *Hyperica* would do well to consider the position of these, among them *H. degenii* Bornm., in relation to *H. annulatum* as well as to *H. atomarium* and *H. lanuginosum*. I regret that my work on the African flora will not allow me to digress further into this fascinating and much needed field for research.

E. Milne-Redhead.

Vismia pauciflora *Milne-Redh.*, sp. nov. ; a *V. orientali* Engl. foliis brevius petiolatis, inflorescentiis tantum 2–4-floribus facile distinguenda.

Arbor circiter 9 m. alta. *Rami* et *cortex* ut in *V. orientali* sunt. *Folia* decidua, glabra, breviter petiolata, petiolis vix 2 mm. longis ; laminae late ellipticae, usque 6·5 cm. longae et 3·9 cm. latae, apice breviter acuminatae, basi late cuneatae, margine obscure crenatae, in pagina et sub marginem glandulis nigro-punctatis ornatae ; nervi laterales utroque latere costae circiter 6. *Inflorescentiae* ramos laterales 4-foliatos terminantes, cymose 2–4-florae ; pedicelli 8–11 mm. longi. *Sepala* glabra, ovata, circiter 4 mm. longa, subacuta, glandulis linearibus ornata. *Petala* oblongo-elliptica, circiter 7 mm. longa, apice rotundata, intus medium versus breviter villosa, glandulis linearibus ornata. *Staminum phalanges* calyci longiores, circiter 15-andrae, glabrae. *Staminodia* carnosa, glabra. *Ovarium* 5-loculare, loculis circiter 5-ovulatis ; styli recurvati, stigmate capitato instructi. *Fructus* ignotus.

Tanganyika. Lindi District. Rondo Plateau, Mchinjiri, on the edges of patches of secondary forest and thickets in old cultivation grasslands, 810 m., Dec. 1951, *Eggeling* 6414 (K, holotypus, EA, isotypus) :— tree, 9 m. high ; leaves whitish below dotted with black glands which also line the margins ; flowers white with brown lines. Lindi District. Without locality or date, *Gillman* 1556 (EA).

This tree is known only from the above quoted gatherings, and it has not yet been collected in fruit. It approaches *V. orientalis* Engl. in many respects and is clearly closely allied to that species. Besides the diagnostic characters given above, *V. pauciflora* differs from *V. orientalis* in having the ultimate reticulations of the nerves on the under surface of the leaves visible to the naked eye and in a more marked difference in size between the lower and the upper pair of leaves of the 4-leaved flowering shoots.

E. Milne-Redhead.

Ebenaceae

Diospyros virgata (*Gürke*) *Brenan*, comb. nov.

Maba virgata Gürke in Warb., Kunene-Sambesi-Exped. 327 (1903).

In placing *M. virgata* in *Diospyros*, I follow the view of Bakhuisen van den Brink (Gard. Bull., Straits Settlements, **7,** 161 *sqq.* : 1933).

J. P. M. Brenan.

RUBIACEAE

Oldenlandia (Subgenus *Orophilum*) **aegialodes** *Brem.*, sp. nov. ; stylo hirtello ad *O. hockii* De Wild. accedens, floribus in cymas dispositis ab ea diversa, foliis ovatis et floribus distincte pedicellatis, corolla dense barbata *O. geophilae* Brem., *O. friesiorum* Brem., *O. rupicolae* (Sond.) O. Ktze. similior, stipulis setas in 2 productis *O. geophilae* solum comparanda sed internodiis multo longioribus, foliis succulentis, siccitate brunnescentibus, nervis inconspicuis ab ea faciliter distinguenda, habitu speciebus procumbentibus subgeneris *Anotidopsis* et floribus heterostylis imprimis *O. verticillatae* Bullock ex Brem. similior, sed stigmatibus elongatis, corolla intus dense barbata a speciebus subgeneris illius valde diversa.

Caules decumbentes sed nunquam radicantes ; caules ramique bisulcati, dimidio superiore internodiorum ad marginem sulcorum papillis conicis scabridi, ceterum glabri, 0·5–1·2 mm. diam., internodiis ad medium caulem 1·5–4 cm. longis. *Folia* petiolo circ. 1 mm. longo, maxima parte cum vagina stipulari connato, marginibus papillis conicis scabridis instructa ; lamina ovato-elliptica, plerumque 7–9 mm. longa et 4·5–6·5 mm. lata, apice acuta, basi rotundata, succulenta, margine dimidio inferiore papillis conicis scabridis revoluta, ceterum utrimque glaberrima, costa basin versus impressa, subtus vix prominula, nervis inconspicuis ; vagina stipularis circ. 1 mm. alta, extra dense papillosa, inter folia in lobum late deltoideum vix 0·5 mm. longum producta, lobo apice in dentes duos 0·3 mm. longos producto. *Flores* apice ramorum in corymbum congesti, heterostyli, ramulis corymbi brevibus, pedicellis 1·5–2·5 mm. longis, glabris, basi bracteis ovatis pellucidis circ. 1 mm. longis suffultis. *Calycis lobi* glabri, ovato-triangulares, circ. 1 mm. longi. *Corolla* viridula, extra subglabra, tubo 1 mm. longo intus dense barbato, lobis 1 mm. longis. *Stamina* in flore dolichostylo adhuc solo noto paulo infra incisuras corollae inserta ; antherae subsessiles, lineares, 0·6 mm. longae. *Granula pollinis* 3-pora, 20 μ longa et 18 μ diam. *Ovarium* glabrum. *Stylus* dense hirtellus, in flore dolichostylo 2 mm. longus, stigmatibus 0·4 mm. longis. *Capsula* glabra. *Semina* pauca, subglobosa, saturate brunnea ; cellulae testae parietibus rectis instructae, laeves.

Habitat insulam Mafiam in Africa Orientali, ubi in litore crescit.

TANGANYIKA. Mafia Island, Kikutani, very common in sand overlying recent coral in association with a Labiate and *Acanthaceae* near the sea-shore above high-water mark, 3 m., 3 Sept. 1937, *Greenway* 5236 (K, holotypus, EA, U, isotypi) :—perennial procumbent herb with umbels of inconspicuous greenish-white flowers and very fleshy leaves.

C. E. B. BREMEKAMP.

Kohautia densifolia *Brem.*, sp. nov. ; subgeneris *Eu-kohautiae*, series *Noctiflorarum* granulis pollinis 4-colporatis, corollae lobis subacutis, floribus plurimis subsessilibus, antheris parte dilatata tubo fere dimidio brevioribus, inflorescentia pauciflora, caule basi ramificato, internodiis inferioribus caulium brevibus ad *K. brachylobam* et *K. longiscapam* accedens, sed habitu suffruticoso, foliis longioribus et angustioribus ab eis faciliter distinguenda.

Suffruticosa, caulibus e basi decumbente ascendentibus ; partes inferiores caulium lignosae, usque ad 2·5 mm. diametro, cortice rubro-

brunneo obtectae, efoliatae ; partes annotinae basi internodiis perbrevibus instructae et folia inde valde congesta ; internodia 2 vel 3 inflorescentiam precedentia 6–7 cm. longa et circiter 0·6 mm. diametro, scabridula, foliis parvis vel interdum fere ad nihilum redactis instructa. *Folia* acicularia ; basalia 2·5–4 cm. longa et 0·7–1·2 mm. lata, anguste hyalino-marginata, margine et costa scabridula, costa albida vel rosea supra impressa subtus prominula, nervis inconspicuis. *Vagina stipularis* utroque latere caulis in lobum triangularem hyalinum producta, lobo margine colletris aliquibus subsessilibus instructo, apice plerumque in colletros duos paulo longius stipitatos exeunte. *Inflorescentia* pauciflora, nunc simplex, nunc basi dichasialis vel pseudo-dichotoma, floribus ad nodos interdum in paria dispositis, casu quo altero subsessili altero ut flore centrali dichasii pedicello usque ad 1·5 mm. longo elato. *Ovarium* hispidulo-papillosum. *Calycis lobi* subulati, 2 mm. longi, hyalino-marginati, margine scabridulo-papillosi. *Corolla* alba, brunneo suffusa, extra glabra, tubo 10 mm. longo parte angusta 7·5 mm. longa et 0·6 mm. diametro, parte dilatata 2·5 mm. longa et 1·5 mm. diametro, limbo usque ad basin partito, lobis 4·5 mm. longis et 1·5 mm. latis, subacutis. *Antherae* 1·6 mm. longae, apice siccitate nigrescentes. *Granula pollinis* 4-colporata, 14 μ alta et 12 μ diametro. *Stylus* 3·0 mm. longus ; stigmata 1·2 mm. longa. *Capsula* hispidulo-papillosa, 3 mm. alta et 3 mm. diametro. *Semina* madefacta glutinosa.

Southern Rhodesia. Sebungwe District. Dongamusa River (tributary of Lutope), 16 km. north of Nkoka's kraal, on forest sandstone by river, 7 Aug. 1952, *Wild* 3847 (S.R.G.H. 37489) (K, holotypus, SAL, U, isotypi) :—flowers white with brownish tinge.

This seems to be a caespitose plant, and in this respect it resembles *K. caespitosa* Schnizl., from which it is at once distinguishable by the shorter length of the internodes in the leafy part of the shoot, and by the shorter anthers.

C. E. B. Bremekamp.

Kohautia caespitosa *Schnizl.* var. **hispidula** *Brem.*, var. nov. ; ovario hispidulo-verruculoso, corolla extra glabra, stylo parte angusta tubi dimidio breviore ad var. *delagoensem* accedens, sed caulibus ramisque ubique scabridulo-hirtellis, foliis angustioribus, latitudine raro 1·5 mm. excedentibus ab ea recedens.

Kenya. Northern Province. El Wak, 2°45′ N., 40° 56′ E., flat gypsaceous limestone plain, soil white, over-grazed *Commiphora-Acacia* open scrub, with abundant *Aloë* and other succulents, 360 m., 26 May 1952, *Gillett* 13341 (K, holotypus, U, isotypus) :—corolla brown ; common.

C. E. B. Bremekamp.

Paraknoxia parviflora (*Stapf ex Verdcourt*) *Verdcourt* [in Bull. Jard. Bot. Brux. **22** : 265 (1952), *nomen eventuale*] *ex Brem.*, comb. nov.

Pentanisia parviflora Stapf ex Verdcourt in Kew Bull. **1951** : 383 (Jan. 1952) ; in Bull. Jard. Bot. Brux. **22** : 263 (Dec. 1952).

Paraknoxia ruziziensis Brem. in Bull. Jard. Bot. Brux. **22** : 77 (June 1952).

Southern Rhodesia. Mazoe District. Mbebe Beacon, among ironstone crags, 1500 m., *Wild* 3771 (S.R.G.H. 35775) (K, SAL, U) : — herb 15 cm. high ; limb pure white, tube pale green.

This species, which was collected for the first time in Uganda (cf. Bullock in Kew Bull. **1933** : 80 : 1933), is in Verdcourt's "Revision of the genus Pentanisia" in Bull. Jard. Bot. Brux. **22** : 1952) recorded also from Kenya and the eastern part of the Belgian Congo. Dr. Wild's collection proves that it occurs even much further to the south. It is apparently a plant from the higher regions, for the altitudes at which it was collected vary between 1100 and 2030 m.

That I maintain my genus *Paraknoxia* for this species, rests mainly on my conviction that the structure of its fruits is of another type than that of the fruits observed in the true representatives of the genus *Pentanisia*. Mr. Verdcourt describes the fruits of this species as 2-coccous and tardily dehiscent, but although I admit that the dissepiment consists of two sclerenchymatous layers separated by a thin-walled parenchyma, and that the fruit, if a sufficient pressure is exercised, splits into two cocci, I do not believe that it can be regarded as dicoccous, for the splitting does not seem to take place under natural circumstances. The fruits are, at any rate, always intact at the time they are shed, and are, in my opinion, better described as nuts. Mr. Verdcourt himself draws attention to a very curious fact in stating that "when the fruit breaks off, a little cup is left, being the persistent woody flanged pedicel", a phenomenon which apparently is confined to this species. The shedding of the fruit is effected by a well-marked abscission-layer, and the base of the nut is characterized by the presence of a large number of very conspicuous raphide cells; in fact, the latter are here far more numerous and far more conspicuous than in the dissepiment.

The calyx-lobes of this species were described by me as equal, but this is an exception; as a rule, one or two of them are somewhat enlarged.

C. E. B. Bremekamp.

Boraginaceae

Heliotropium sudanicum *F. W. Andr.*, sp. nov.

[*Heliotropium europaeum* (non L.)—Broun & Massey, Fl. Sudan, 306 : 1929].

Affinis est *Heliotropio tiaridioidi* Cham. speciei americano sed pilis bibrachiatis "malpighiaceis" vocitatis absentibus, ovario glabro distat.

Herba annua, ramosa, usque ad 30 cm. vel ultra alta, ramis sulcatis; planta, in partibus juvenilibus praesertim, pilis simplicibus brevibus plerumque adscendentibus basim illorum versus sensim dilatatis hinc anguste conicis scabrido-pubescens vel hispidula. *Folia* alterna vel subopposita, margine paulum repando-crispatula, ovata, basim versus cuneata et saepe paulum inaequalia, apice acuta vel obtusa, circiter 2–7 cm. longa et 1·2–3 cm. lata, scabra, subtus nervis hispidulis at inter illos confertim ac minute tuberculata, supra pilis tuberculisque commixtis minus confertis; petioli usque ad 2 cm. longi, hispiduli. *Spicae* densiflorae, saepe binae, primo breves et circiter 0·4–1 cm. longae, mox usque ad circiter 4–9 cm. elongatae. *Sepala* oblongo-lanceolata, acuta, 2 mm. longa, 0·75 mm. lata, pubescentia. *Corolla* alba, parva, 3·5–4 mm. longa; tubus 2·5 mm. longus, 1 mm. diametro, extra pubescens; lobi suborbiculares, circiter 1 mm. diametro, utrinque glabri. *Stamina* 5; antherae subsessiles, in medio tubi insertae. *Ovarium* glabrum. *Stylus*

brevis, circiter 0·25 mm. longus, glaber. *Stigma* conicum, circiter 0·75 mm. longum, basi 0·4 mm. latum, truncatum, fuscum. *Nux* glaber, circiter 2·5–3 mm. longum, 3–4 mm. latum.

Anglo-Egyptian Sudan. Gezira Research Farm, 4 Aug. 1948, *Mohd. Ismail* J.45 K, holotypus, A, BR, FI, isotypi :—common weed of cultivation.

Tanganyika Territory. Mpwapwa, 5 Feb. 1930, *Hornby* 172 :—weed 30 cm. high, in good soil. Without locality [probably Mwanza], *R. L. Davis* 147.

This plant is a common weed of cultivation in the Gezira cotton area of the A.-E. Sudan, its abundance possibly accounting for its absence from collections and the paucity of material in herbaria.

Dr. Ivan M. Johnston, Arnold Arboretum, to whom a duplicate of *Mohd. Ismail* J.45 was sent, kindly writes : "Your African plant is evidently related to *tiaridioides*, but differs from it in lacking malpighiaceous hairs and in having a glabrous ovary . . . . . I should say that it does not appear to be the same as any of the African relatives described by Vatke. I have compared your plant with fragments of Vatke's types which I was given many years ago at Berlin. I am inclined to believe that you have an undescribed species, and I would suggest that it be published as such. Of one thing you can be sure—it is not an introduced American plant, and I am positive that it is not any of the Asiatic or Australian forms. I think you will find that it is indigenous to Africa."

Among African species of *Heliotropium* it differs from *H. indicum* L. among other characters by being a less robust plant, and having smaller leaves and a conical stigma ; *H. persicum* Lam. is a perennial.

F. W. Andrews.

Scrophulariaceae

Dopatrium caespitosum *P. Taylor* sp. nov. Fig. 1 1–8 ; *D. nudicauli* (Willd.) Benth. affinis, sed foliis angustioribus obtusis, capsula breviori differt.

Herba annua, caespitosa, glabra, 5–8 cm. alta. *Folia* radicalia, numerosa, opposita, sessilia, basi connata, obovata vel elliptica, obtusa, 4–15 mm. longa, 1·5–4 mm. lata, nervis primariis tribus necnon nervis secundariis anastomosantibus praedita. *Scapi* 3–10, erecti. *Racemi* unilaterales, 1–5 - flori. *Bracteae* obtusae vel subacutae, oppositae, ovatae, basi connatae, trinerviae, circiter 2 mm. longae, 1·5 mm. latae. *Pedicelli* tenues, 10–25 mm. longi, sub anthesin erecti, fructiferi valde reflexi. *Calyx* regularis, 5-dentatus, persistens, campanulatus, circiter 3 mm. longus, dentibus circiter 1·5 mm. longis angustis acutis. *Corolla* bilabiata, caerulea, labio inferiore macula lutea notato : tubus rectus, circiter 3 mm. longus, 1·5 mm. diametro ; labium superius plus minusve orbiculare, 2·5–3·5 mm. diametro, integrum vel emarginatum ; labium inferius trilobatum, lobis lateralibus 3–4 mm. longis 2–3 mm. latis integris, lobo medio 4–5 mm. longo, 5–6 mm. lato, emarginato. *Stamina* 2, fauce tubi corollae inserta, filamentis circiter 2 mm. longis tortis, antheris pubescentibus cohaerentibus. *Ovarium* ovoideum, circiter 1 mm. longum. *Stylus* tenuis, circiter 2 mm. longus. *Stigma* bilabiatum, labio superiori minuto obtuso, inferiori suborbiculari circiter 0·3 mm. longo emarginato.

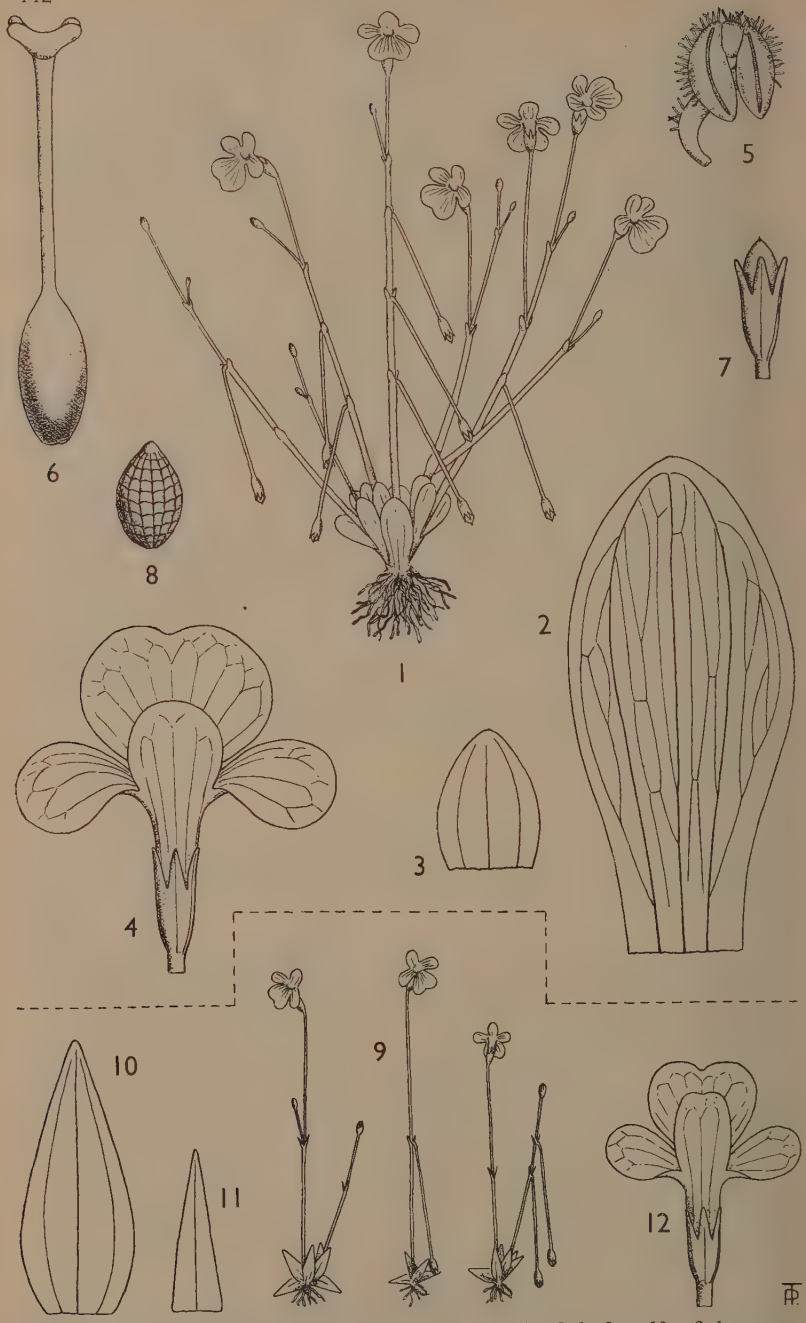

FIG. 1. *Dopatrium caespitosum* P. Taylor—1, plant, × 1 ; 2, leaf, × 10 ; 3, bract, × 10 ; 4, flower, × 5 ; 5, stamen, × 30 ; 6, pistil, × 20 ; 7, fruit, × 5 ; 8, seed, × 30 ; *Dopatrium pusillum* P. Taylor—9, plants, × 1 ; 10, leaf × 10 ; 11, bract, × 10 ; 12, flower, × 5.

Capsula quadrivalvata, anguste ovoidea, circiter 4 mm. longa, quam calyx paulum longior. *Semina* ovoidea, reticulata, circiter 0·5 mm. longa.

Angola. Moxico District. Ikula Hot Springs, by R. Zambezi, in damp peaty soil between exposed rocks, 17 Jan. 1938, *Milne-Redhead* 4177 (K, holotypus)—densely tufted, forming masses, roots white, leaves bright green, calyx greenish blue, corolla blue with bright yellow spot on lower lip.

The small size, tufted habit and strongly reflexed fruiting pedicels distinguish this species from all other African species of *Dopatrium* except *D. pusillum* (infra). It is however, very closely allied to *D. nudicaule* (Willd.) Benth., a species of southern India and Ceylon. *D. caespitosum* differs from that species in having narrower, more obtuse leaves, capsules scarcely longer than the calyces (those of *D. nudicaule* are twice as long) and in its densely tufted habit.

P. Taylor.

Dopatrium pusillum *P. Taylor* sp. nov. (Fig. 1/9-12) ; *D. caespitoso* P. Taylor affinis, sed omnino minor, foliis bracteisque angustis lanceolatis acutis.

Herba annua, simplex vel caespitosa, glabra, 3–6 cm. alta. *Folia* radicalia, pauca, opposita, sessilia, basi connata, anguste lanceolata, acuta, usque ad 6 mm. longa, 2·5 mm. lata, trinervia. *Scapi* 1–5 erecti. *Racemi* unilaterales, 1–3- flori. *Bracteae* acutae, oppositae, anguste lanceolatae, basi connatae, uninerviae, circiter 2·5 mm. longae. *Pedicelli* tenues, 10–20 mm. longi, sub anthesin erecti, fructiferi valde reflexi. *Calyx* regularis, 5-dentatus, persistens, campanulatus, circiter 2·5 mm. longus, dentibus circiter 1 mm. longis angustis acutis. *Corolla* bilabiata, caerulea, labio inferiore macula lutea notato ; tubus rectus, circiter 3 mm. longus, 1 mm. diametro ; labium superius oblongum, 2–2·5 mm. longum, 1·5–2 mm. latum, obtusum, integrum vel emarginatum; labium inferius trilobatum, lobis lateralibus circiter 3 mm. longis, 1·5 mm. latis, integris, lobo medio 3–4 mm. longo circiter 3 mm. lato emarginato. *Stamina* 2, fauce tubi corollae inserta, filamentis circiter 2 mm. longis tortis, antheris pubescentibus cohaerentibus. *Ovarium* ovoideum, circiter 0·75 mm. longum. *Stylus* tenuis, circiter 1·5 mm. longus. *Stigma* bilabiatum, labio superiori minuto obtuso, inferiori suborbiculari circiter 0·3 mm. longo emarginato. *Capsula* quadrivalvata, ovoidea, circiter 2·5 mm. longa, quam calyx paulum longior. *Semina* ovoidea, reticulata, circiter 0·5 mm. longa.

Angola. Moxico District. Few miles W. of R. Mujilezhi, in vast quantities on shallow wet peaty soil overlying " laterite ", 7 Jan. 1938, *Milne-Redhead* 3957 (K, holotypus) :—small annual ; leaves bronzy-green ; corolla 4-lobed ; lateral and posterior lobes entirely blue ; anterior lobe bifid, white edged blue, with yellow throat ; after flowering pedicels bend to ground.

D. pusillum is closely related to *D. caespitosum* and *D. nudicaule* but is readily distinguished by its even smaller size, its simple or almost simple habit, and particularly by its very small lanceolate-acute leaves and bracts.

P. Taylor.

ACANTHACEAE

Justicia praecox (*Milne-Redh.*) *Milne-Redh.*, comb. nov. et descr. ampl.

Monechma praecox Milne-Redhead in Bull. Misc. Inf. Kew **1937,** 430 (1937).

Caules foliosi basi usque 4 mm. diametro, obscure quadrangulares, sub nodos expansi. *Folia* petiolata ; petioli usque 1·5 cm. longi ; lamina elliptica, 6·5 cm. longa, 2·5 cm. lata, apice ignota, basi in petiolum attenuata, glabra, cystolithis dense instructa. *Capsula* abortu semen unicum ferens, clavata, circiter 3·5 cm. longa, apice apiculata, stipite circiter 2 cm. longo instructa, glabra. *Semen* leviter compressum, obscure cordatum, circiter 7 mm. latum et 3 mm. crassum, testa dense rugulosa instructum.

BELGIAN CONGO. Katanga, locality not stated, in small bush country after the grass has been burnt, Aug. 1938, *Russell* 25.

NORTHERN RHODESIA. Mporokoso District. Mporokoso–Mkupa, in *Brachystegia* woodland, 25 Oct. 1949, *Bullock* 1362, 1385 :—herb with woody rootstock ; flowers white. Solwezi District. Solwezi Dambo, on burnt ground in open, 20 Sept. 1930, *Milne-Redhead* 1150 (K, BR) :—perennial with woody rootstock ; old shoots burnt off ; young flowering shoots rigidly erect ; flowers creamy white.

When I described *Monechma praecox* in 1937, the species was known only from a single gathering in flower, in which state the plant is normally leafless. Owing to the absence of fruit, there was some doubt as to which genus it should be referred. A recent gathering of the plant in fruit made by my colleague, Mr. A. A. Bullock in Northern Rhodesia, shows that I was wrong to have placed it in *Monechma* ; it agrees with *Monechma* in having a potentially two-seeded capsule, but the relatively large size and well developed stipe of the capsule and the rough surface of the seed must exclude it from that genus.

Justicia praecox is, however, anomalous in *Justicia* as defined by C. B. Clarke (Fl. Trop. Afr. 5, 179 : 1899), for that genus should have a 4-seeded capsule. In *J. praecox* the two lower ovules in the ovary appear to be rudimentary and do not develop after fertilization. Six capsules from *Bullock* 1385 have each ripened only one seed, the second of the upper pair of ovules having aborted in a half-grown state. The same condition was observed in an unripe capsule from *Russell* 25.

The axillary cymes in *J. praecox* are very short and reduced in some cases to single flowers. The species would therefore seem to belong to subgenus *Rostellularia*, but in my opinion its affinity lies with species placed in subgenus *Gendarussa*, in particular with *Justicia brevicaulis* S. Moore, a species from Angola having a similar precocious habit. It may be that the strongly hooded posterior lip of the corolla and the large capsule with a well-defined stipe are subgeneric characters of greater importance than the appearance of the inflorescence. In fact Clarke himself states (l.c. 183) that " there is no essential difference between the inflorescence of a species [of subgenus *Gendarussa*] such as *J. cordata* and that of subgenus *Rostellularia*."

Although *J. brevicaulis* was placed by Spencer Moore in subgenus *Gendarussa*, Clarke (l.c. 182) transfers it without comment to subgenus

Calophanoides, where it is undoubtedly out of place. I agree with Spencer Moore in referring it to subgenus *Gendarussa*, where I propose to place *J. praecox* next to it. It is possible that the reduced seed-producing capacity of *J. praecox* is a character closely related to the precocious habit. Not only does the species flower without leaves, but it ripens fruits before the leaf-bearing shoots are produced, drawing the necessary food from the limited reserves stored in the woody underground parts.

One of Bullock's specimens has the remains of the previous season's leafy growth and a single leaf which is here described for the first time.

E. Milne-Redhead.

Labiatae

Nepeta sudanica *F. W. Andr.*, sp. nov. ; *N. bilobae* Hochst. affinis, caulibus canescentibus, foliis late ovatis 3–4 cm. latis subtus canescentibus, pedunculis verticillastrorum usque ad 10 mm. longis, verticillastris nonnunquam extra-axillaribus differt.

Herba vel suffrutex perennis, erecta. *Caules* canescentes. *Folia* crenata, late ovata, basi truncata vel cordata, apice obtusa vel rotundata, 4–5·5 cm. longa, 3–4 cm. lata, supra viridia et pubescentia, subtus dense canescentia et prominenter venosa ; petioli foliorum inferiorum usque ad 1 cm. longi, superiorum breviores. *Verticillastri* usque ad 1 cm. pedunculati, nonnunquam extra-axillares, cymosi, cymulis multifloris usque ad 5 mm. pedunculatis ; bracteae lineari-lanceolatae, dense villosae, calycibus fere aequilongae. *Calyx* dense villosus, 7–9 mm. longus, dentibus linearilanceolatis acuminatis tubo brevioribus, ore obliquo. *Corolla* caerulea usque pallide purpurea, tubo calyce aequilongo vel parum longiore extra hirsuto, parte labiata exserta fauce barbata.

Anglo-Egyptian Sudan. Red Sea Hills : Erkowit, 16 May 1907, *Broun* 1148 (K, holotypus) :—corolla blue. Same locality, 1927, *Lady Maffey s.n.* ; 1928, *Lady Maffey* 24 ; no date, *Lady Maffey* 54. Same locality, 1210 m., 1 Mar. 1932, *Aylmer* 159 :—small shrub ; flowers pale mauve.

This plant is fairly common over the Erkowit plateau, but, as far as is known, is limited to this locality.

It differs from *Nepeta biloba* Hochst., with which it has been confused, by the following characters :

biloba	*sudanica*
Stems pubescent	Stems canescent
Leaves ovate, 1–2·5 cm. broad	Leaves broadly ovate, 3–4 cm. broad
Lower surface of leaves pubescent	Lower surface of leaves canescent
Verticillasters on peduncles up to 6 mm. long	Verticillasters on peduncles up to 10 mm. long
Verticillasters axillary	Verticillasters sometimes extra-axillary.

F. W. Andrews.

The Fungi.*—This is one of those depressing books in which fungi appear to have been created merely to serve as vehicles for the adventures of nuclei of opposite sign or sex. One does not deny the usefulness of an evolutionary hypothesis but there seems to be little gained by filling students' heads with purely speculative lineages, even the more plausible of which can be read either way. But those who like such things will probably concede that both author and translator have done their work well. The text is lucid and concise, perhaps too concise for undergraduate use, and the translation reads easily, though it is a little odd to refer to the Peronosporaceae as " False mildews ". The 440 text figures are clear and well chosen. Particularly useful features of the text are the critical summaries of distinctive characters and specially of the sexual behaviour of individual species or groups.

The classification in the main is up to date and the treatment, with one exception, is reasonably well balanced as shown by the number of pages allotted to each class and the estimated number of species belonging to it.† Four classes and four sub classes are recognised : Archimycetes 16 pages ; Phycomycetes 44 pages, about 1000 species : Ascomycetes with two subclasses, Protascales 22 pages about 270 species, Euascomycetes, 131 pages about 12,000 species : Basidiomycetes also with two subclasses, Holobasidiomycetes, 56 pages, 7600 species, and Phragmobasidiomycetes, 39 pages about 5,800 species. Speculative relationships between Laboulbeniales and red algae, once so popular, are no longer mentioned. The fungi imperfecti with about 10500 species receive scant notice in 1½ pages. The poor things have no sex mechanism but nevertheless contrive to include the most abundant and cosmopolitan fungi and many of the most important pathogens.

In contrast to the treatment of the Ascomycetes that of the Holobasidiomycetes seems strangely old fashioned. Most of their 56 pages is taken up with a discussion of nuclear behaviour and the classification proposed is in essence that of Fries or, at best, of Patouillard. No attempt is made to evaluate the modern systems of Agaricaceae and there is no mention of Corner's studies in hyphal analysis or their possible taxonomic significance. It is strange, too, that authors who have abolished the Pyrenomycetes should retain that obviously polyphyletic order the Gastromycetes. Apart from a vague reference on p. 279 there seems to be no mention of the apparent close relationship between individual genera of " Gastromycetes " and " Hymenomycetes ".

While advanced students may find this book a handy compilation of cytological data one cannot but feel a youthful mycologist reared in its highly academic atmosphere will be sadly lost when he finally escapes and confronts the fungus kingdom as it actually exists in nature.

R. W. G. Dennis.

* The Fungi, a description of their morphological features and evolutionary development. E. A. Gaumann, translated and arranged by F. L. Wynd. Hafner Publishing Co., New York–London 1952. 420 pp. £3 : 12 : 6.

† after Buller & Ainsworth in Trans. Brit. Mycol. Soc. 26 p. 16. 1943.

Microscopy of Wood and Paper.*—It is well known that a high proportion of the large works of reference dealing with scientific subjects are published in Germany. Indeed our German-speaking colleagues appear to have a marked capacity for collecting factual information in books of encyclopaedic proportions where it is readily available for consultation. The two parts of the volume now under review represent only a portion of a vast book consisting of eight volumes, and intended to cover the great variety of purposes for which the microscope is used in modern science and technology. It will at once be realized that such an ambitious task could be successfully undertaken only by enlisting the co-operation of specialists, of whom about 55 are responsible for different parts of the whole work. The book is, however, being edited by one man, Dr. Hugo Freund of Wetzler.

The 2 separately bound parts of the fifth volume contain subject matter of interest to botanists, as well as to wood technologists and paper manufacturers, since it deals with the microscopy of wood and of paper-making materials. The book is not solely of interest to applied botanists, however, for it includes a comprehensive history of plant anatomy from the time of Nehemiah Grew to the present day, and an account of the structure of fossilized woods. To make the range of subjects that are dealt with more fully understood, it may be stated that Volume V, like the work as a whole, consists of a number of independent essays, the full scope of which is indicated by the following particulars. The first half of the volume contains 4 essays on the following subjects. (1) The History of Wood Anatomy, by Drs. T. Schmucker and G. L. Linnemann, pp. 1–79. (2) Microscopic Investigation of Wood, by Dr. Bruno Huber, pp. 80–192. (3) Anatomy of Central European Barks, by Dr. W. Holdheide, pp. 193–368. (4) Submicroscopic Structure of Wood and Fibres by Dr. H. Ziegenspeck. The second part of the volume contains the following essays. (1) Microscopy of Wood in Relation to its Working Properties, by Dr. H. von Pechmann, pp. 457–505. (2) Microscopy of Wood Fibres by Dr. R. Runkel, pp. 507–543. (3) Determination of Fibre Length by Drs. G. Jayme and Marianne Harders-Steinhaüser, pp. 547–572. (4) Microscopy of Paper and its Raw Material, by Dr. E. Liebert, pp. 575–724. (5) Microscopy of Decomposed and Fossilized Woods, by Dr. W. Müller-Stoll, pp. 727–816. (6) Microscopical Detection and Identification of Fungi inhabiting Wood, by Dr. W. Bayendamm, pp. 819–843. (7) Identification of technically important Beetles by the Use of Lens and Microscope, by Dr. H. Schmidt, pp. 847–886.

The book, which is well bound and printed on good paper, is copiously illustrated with photomicrographs which are mostly excellent in quality, a few of the photographs being in colour. There is a selected bibliography at the end of each essay, and there are separate indexes to authors and subjects at the end of each of the separately bound parts of volume V.

The individual essays are practically self-contained units, although there are occasional cross references. It is impossible for any one reviewer to pass judgment on the merits of each essay since they cover such a range and diversity of topics, but those dealing with subjects with which the present reviewer is most familiar are clearly of a very high order. The chief weakness in Vol. V, as a whole, lies in the very fact that

it consists of independent essays, since this method of treatment has led to considerable overlapping of subject matter. In consequence it is necessary to consult various parts of the book in order to obtain all of the information it contains concerning any one topic. In addition many specialists who cannot possibly afford the necessarily very high cost of such a luxurious publication would undoubtedly be willing to pay a lower price for the essays that appeal to them individually. For example many of those who are concerned with the manufacture of paper would welcome Dr. Liebert's admirable article on the microscopy of paper and the raw materials from which it is prepared. These same paper technologists might find Schmucker and Linnemann's excellent introductory essay on the history of wood anatomy less essential. The fact that the essays have been bound together means, however, that the book will find a place only on the shelves of those reference libraries that are able to afford it. In spite of its high price it is a book that ought to be in as many reference libraries as possible.

It is also impossible in a review of such a large work to comment on the numerous points to which attention could usefully be directed. It may, however, be mentioned that students of the history of botany are likely to be intrigued by the impressive portrait gallery of plant anatomists. Surely no such collection of photographs of well known figures in this field of enquiry can ever before have been assembled. Microscopists who have to identify barks will welcome Dr. Holdheide's article on those of 50 species of common European trees, illustrated by 107 photomicrographs. No comparable atlas of barks exists elsewhere, Moeller's classical work on this subject being now out of date. It is to be hoped that an atlas on similar lines, but dealing with at least the more important of the barks with economic uses from other parts of the world will ultimately be made available, as our knowledge of bark structure from the taxonomic angle is still very meagre. Dr. Huber's article on wood structure provides a modern, balanced account of this topic. The subject of wood structure has, however, been more exhaustively treated than that of bark structure in recent years, so that this article mostly contains information that is already well known from other sources. This article includes a section on the dating of wood specimens by studying the sequence of annual rings. Drs. Jayme and Harders-Steinhauser describe a new method for determining and recording the lengths of fibre cells in paper pulp which it is claimed gives results of greater significance than previous techniques in assessing the technical qualities of the pulp. Dr. Liebert's article dealing with paper and paper pulp is far more comprehensive, however, and is written from the standpoint of an investigator who has to contend with the everyday problems that the microscopist in a large paper mill is likely to encounter. Dr. Müller-Stoll's essay, written mainly from the palaeobotanical angle, will no doubt prove useful to all those who have to study decaying or fossilized wood, and he has much that is of great value to say about the difficulties that arise when microscopical comparisons are made between fossilized wood and timber of present day trees.

It should be mentioned that each essay includes practical directions for use in the laboratory. Methods of cutting sections, macerating, staining and so forth are given, and sometimes, as for example in Dr. Ziegen-

speck's essay on the submicroscopic structure of wood and fibres, modern techniques such as phase contrast microscopy and the use of the electron microscope are briefly described.

Only a few minor errors have been noted. Attention should, for example, be drawn to the fact that A. W. Hill (p. 51) was not a Professor in London but a lecturer at Cambridge at the time when he worked on the structure of sieve tubes. The date of the work by S. H. Clarke, to which reference is made on p. 66, is 1938 and not 1838. Pp. 79–80 are missing from the copy received for review. These are, however, but small blemishes in a book that is so comprehensive in scope.

The individual essays deserve to be widely known not only amongst specialists in the topics with which each of them deals, but also amongst those hard pressed workers in other fields who wish for summaries of what is going on outside the boundaries of their own enquiries. Is it too much to hope that the publishers will see that it is in the best interests of science to make information available to all who can profitably use it at a price that they can afford to pay, rather than to restrict the disemination of knowledge by publishing luxury editions at a high price ?

C. R. METCALFE.

The Australian Roadside.†—It is clear from this book that England is not the only country in which the activities of planners threaten to interfere with the natural beauty of the countryside. Miss Walling concentrates, however, on the spoliation of the roadside scenery in Australia, especially along the main roads, by the extensive tidying up and replacement of native plants by exotic trees and shrubs. Her advocacy of the carefully controlled development of the natural vegetation in such places will be supported by all ecologically minded persons no less than by true lovers of nature. The book is beautifully illustrated with numerous photographs of scenery, trees and other native plants along many of the main roads of Victoria and will give the outsider a vivid idea of the natural charm of this as yet mainly unspoilt countryside. It is to be hoped that the policy advocated in the book will meet with active support from all those who are interested in the preservation of the scenic amenities of Australia.

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* Handbuch der Mikroskopie in der Technik. Freund, Hugo. Band V (2 Teile). Mikroskopie des Holzes und des Papiers. Part 1 pp. 1–456 + XLVI. Part 2 pp. 457–891 + XLVI. Umschau Verlag, Frankfurt am Main 1951. Price 69 marks for each part.

† The Australian Roadside, by Edna Walling. Pp. XII + 112, 82 photographs. Geoffrey Cumberlege, Oxford University Press, 1952. Price 30/-.

New Zealand Pollen Studies.*—The study of pollen and other spores (palynology) has increased in popularity in recent years. The fact that many spores retain characters, enabling the producing plants to be more or less precisely determined, not only in dried herbarium specimens but also in many natural deposits of a fossil or semi-fossil nature, gives them special taxonomic and palaeo-botanical importance. The reliability of palynological conclusions depends, as in all biological investigations, on correctness of determination. This is true whether pollen grains (or other spores) are studied in relation to disease (allergies), to past climates, to floristic or vegetational histories, to phylogeny, or to general taxonomy.

The work* of Miss L. M. Cranwell breaks what is largely new ground in dealing with the pollen grains of many of the monocotyledons of the New Zealand flora. The narrow range of diagnostic characters of pollen grains, within the Monocotyledoneae, often makes intergeneric and even interfamily differentiation impossible. Types with bilateral symmetry, characterized by a single furrow or pore are supposed to be ancestral to those with no recognizable apperture. There are, however, various aberrant shapes.

Miss Cranwell provides a key to the pollen grains of New Zealand monocotyledons, at least to the family, but most of the text is occupied by detailed descriptions and discussions and by references to previously published work. There is a table of the salient pollen characters of New Zealand monocotyledons, a seven page list of references, and an index. A notable feature is the set of eight collotype plates of pollen grains. The photomicrography and reproduction of these are excellent.

W. B. Turrill.

Sanders' Encyclopedia of Gardening.†—The first edition of this Encyclopedia appeared in 1895. Previously it had been published in serial form in *Amateur Gardening*. It is a work of many editions, the demand for which has by no means diminished with the years, and it says much for the reliability of the information presented that yet another should be published, bringing the total to twenty-two. Mr. Hellyer, the editor of *Amateur Gardening* is responsible for this new edition which has been completely revised and brought up to date. Information is given on the propagation and care of cultivated plants, the botanical and common names being arranged together in alphabetical sequence. The scope of the book is considerable ; it deals with planting, soils, position, pruning, manuring, greenhouse temperatures, etc., while changes in nomenclature have been noted and synonyms included.

This is an eminently practical work, maintaining the standard and reputation earned by previous editions, and will be of great assistance to everyone with an interest in gardening.

H. S. Marshall.

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* New Zealand Pollen Studies, the Monocotyledons, a comparative account, Bull. Auckland Inst. and Mus. No. 3 (1952), by Lucy M. Cranwell. Harvard University Press. London : Geoffrey Cumberlege. 32s. 6d. net.

† Sanders' Encyclopedia of Gardening. Ed. 22. Revised by A. G. L. Hellyer. Pp. x + 524. London : W. H. & L. Collingridge Ltd., 1952. Price 21/-.